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Regulation and Municipal Operation

The tendency manifested in nearly all public-utility measures now pending before the various state legislatures to exempt municipally owned and municipally operated systems from the provisions of the acts is vicious and certainly against public policy. Such flesh and red-herring legislation can only react to the detriment of the consumer in whose interest it is apparently framed; for experience has shown that of all utilities those operated by municipalities are most in need of regulation, especially as regards quality of service and financial methods. The consolidation of properties and the realization on the part of electric-railway companies that it is more economical to purchase energy than to generate it mean that the day is not far off when there will be fewer, but larger, generating stations. Then, owing to the intenser development and to the diversity-factors of the loads, rates for service will reach a point where small or municipally operated systems can no longer compete for business—because they cannot obtain more favorable load-factors or diversity-factors than the community affords. Such, however, is not the case with a large system catering to the needs of many communities and carrying a more diversified load. Naturally, the tendency of the municipally operated system will be to ward off the inevitable as long as possible and in doing so to resort to measures that would not be tolerated by a public service commission. This condition points to the need of some competent body to conserve the interest of the taxpayers and shows the fallacy of rendering municipally operated utilities immune from public-service regulation.

Simplicity in Consolidation

The wholesale consolidation of numerous small public-service companies during the last twelve months is bringing into prominence the importance of eliminating as much "red tape" as possible from the general supervision and management of such groups of small units. While syndicate management of central stations operating in communities of 20,000 or more inhabitants has been common for many years, the wholesale acquisition of small properties by syndicates is comparatively recent. It must be obvious that, as compared with city systems, greatly simplified methods must be pursued in the records and management of a company composed of many such small units, otherwise the "red tape" necessary to manage these small plants from a central office will be out of proportion to the gross receipts. The records kept of small properties have frequently been insufficient. The incoming consolidated management taking hold of such plants is likely to go to the other extreme on account of the inexperience of the men at the head of affairs with the operation of such small units and of a desire to carry the methods used in large properties into the smaller ones. If the consolidations of the smaller plants are to be successful, it is essential to eliminate unnecessary expenditure of time and money keeping little used records. The best of judgment is needed to determine how much red tape and system can be done away with without affecting the net results disadvantageously. The bad effect of too much red tape shows up most strongly in connection with the small plant in the bookkeeping and the making out of reports. To be sure, it is better to have too many records than too few, but a study of the reports and systems of most plants will show that some records and reports are costing much more than they are worth.

Flat-Rate Problems

We have often referred to the successful working of the flat-rate campaign for small residences conducted by Mr. A. C. Dunham, of Hartford, Conn., who, despite his years, has been on the firing line of progress for more than two decades. Since his retirement the same policy has been carried on, until now nearly 75,000 contract lamps are used in Hartford residences and there is a much greater general utilization of electricity in Hartford than is to be found in most cities of very much larger size. The latest form of flat rate which has been brought to our attention is in force in a neighboring city, where the scheme is reduced to the rudimentarily simple form of furnishing 100 cp in tungsten lamps for $1 a month, and more at the same rate if needed. This arrangement enables the consumer to know in advance exactly what his bill is going to be and to distribute his available lighting sources in such form as suits his convenience. The original Hartford scheme contemplates the use of either 25-watt or 30-watt tungsten lamps, while the modified contract here referred to might well, for example, be worked out on the basis of one 40-cp lamp and three 20-cp ones, or similar combinations as might prove convenient. Of course, if all these lamps were used continuously the company would lose money, but the whole plan is based on the law of averages as applied to human nature. Where there is one person who would use his lamps unreasonably just because he had the privilege, there are two or three who appreciate their benefits enough to exercise the same reasonable caution in using light that they would if the lamps were installed with a meter. Very few people are disposed to take mean advantage of one who is trying to give them a square deal, and the experience at Hartford has shown that the prices obtained for contract lighting when reduced to a kilowatt-

hour basis are remunerative ones. The hundred-candles-for-a-dollar proposition ought, under ordinary circumstances of use, to result in from 8 to 9 cents per kw-hr., which, considering the simplicity of accounting and the absence of all meter expense, is a very satisfactory figure. It is particularly advantageous by reason of the fact that the load thus taken on is added to that which may be reasonably expected on a strictly meter basis and is very largely off-the-peak load, which of itself would justify some concession in price. It is, too, a load of low demand, since at a fixed price only lamps intended to be used regularly will be installed and there is no chance of unusually high peaks. Of course, the plan is one that appeals only to the small user, who is the very person who hesitates to accept the meter basis of charge. The plan is unscientific from the standpoint of the maker of rates, but it provides new business which is reasonably profitable and it goes one step further toward making electric service a general necessity. The ordinary dwelling of fair size could more cheaply adopt the meter basis of charge, for the total number of lamps is likely to be from 25 to 50, which, even if of small size, would result in a monthly bill on the contract basis greater than any probable meter bill. But with small apartments and the little houses of workingmen the balance goes quite the other way. The contract plan is, therefore, one to be used rather as auxiliary to the ordinary system of rates than as a general basis of lighting sales, but in this auxiliary function it looks decidedly promising.

A Study of Street Lighting

One of the most important contributions to the problem of street-lighting design which have appeared in a long time is a paper before the British Institution of Electrical Engineers by Messrs. Pearce and Ratcliffe, noted in our *Digest*. It deals with the experiments carried on in Manchester, some of which have already been referred to in our columns. The particularly important phase of the investigation is that some time ago a careful comparison was instituted on a practical scale between high-pressure gas-lighting and flame-arc lamps, as regards both effect and economy. In each case the lamps were spaced at a little over 100 ft. and at a height of 27.5 ft., the gas lamps being Keith three-burner units, rated at 4500 cp, and the electric lamps yellow-flame arc units of the magazine type taking 11 amp. The expense of maintenance on both these systems was very carefully studied and thorough measurements of the illumination were made. The investigation showed that from the economic standpoint gas is quite out of the game, being considerably higher than electric lighting both in fixed charges and operating costs. In fact, for equal illumination the arc lighting costs less than 40 per cent of the press-gas lighting.

The authors of the paper go so far as to say that electric lighting possesses all the practical advantages, although they state that the press-gas lamps were slightly steadier and less glaring than the arc lamps. It is a little difficult from the facts given to evaluate the difference in cost between the two illuminants with precision, inasmuch as one is dealing with a municipal plant, and it is clear that the figures, particularly those relating to fixed cost, are not accurately ascertainable unless when dealing with a much larger number of lamps than were here used. It is equally clear, however, that the discrepancy in the figures given is far too great to be obliterated by any of these considerations. It is not a question of one lamp costing a few shillings a year more than the other, but of the one costing several times as much as the other. One of the conspicuous reasons for the practical economical failure of the press gas was that not only the particular lamps here used but a number of others, of which tests were available, showed a great deficit in actual candle-power below the rating, all the press-gas lamps tested giving roughly only about half their reputed output. The 4500-cp lamp used in the test gave only as the average maximum reading about 2300. The flame-arc lamps did relatively very much better. The raw results of this comparison are thoroughly in line with those we have at various times indicated on the basis of experience elsewhere. The press-gas lamps certainly give a beautiful light, but at the prices charged for energy in America they seem to stand a very small chance of economic success.

Incidentally, the Manchester investigation brought out many points of technical interest. In the first place the photometric work by the somewhat unusual method of flicker photometry, to obviate the differences in color, seems to have been thoroughly done. The flicker instrument was found somewhat troublesome to use, but otherwise satisfactory. The illumination was measured on the horizontal, a meter above the ground, and in the arc-lighted street the minimum intensity was found to be about 0.5 ft.-candle, while the ratio of minimum to maximum, referred to as the variation-factor of the illumination, was 3.75. Tests were also made with a reading lumenometer. These tests, which are, of course, less precise than photometric readings but still not without value in conjunction with photometry, showed consistently the curious condition of something like 25 per cent greater apparent illumination from the arc lamps than was derived from the candle-power readings. This difference must probably be charged to the quasi-monochromatic character of the light from a yellow-flame arc lamp. The same phenomenon is even more strongly marked in comparing the mercury-arc lamp with a source giving a continuous spectrum.

Another interesting phase of the study was the testing of globes with reference to their effect on the distribution. The first installation was with clear inner globes and opalescent outer ones, the latter serving in a measure to improve the distribution; but this arrangement was found unsatisfactory and it was advisable later to substitute an etched globe of somewhat different shape. The best results were obtained by a graduated etching, light in the upper part of the globe and stronger at its base. The change effected by this modification of the glassware was very striking, the angle of maximum candle-power being raised considerably nearer the horizontal. Dioptric inner globes were also tried both with clear outer globe and with the graduated etching referred to, and also with slightly opalescent outer globe. With the aid of diffusion the dioptric inner globes performed well but were found

somewhat hypersensitive to the position of the arc, so that their use was looked upon as of a somewhat dubious advantage.

All things considered, the Manchester experiments seem to have made it very plain that flame-arc lamps when judiciously used can be made to give considerably more economical street lighting when intense illumination is required than can high-pressure gas lamps, but that there is considerable yet to be learned about the best way of installing very high-power illuminants. The intensity of illumination reached was higher than is familiar in American practice, and the figures for costs would require considerable revision if applied here. There is little doubt, however, that the balance would still remain on the same side, and that under present conditions there is little to encourage any American municipality in undertaking high-pressure gas lighting.

More Light on the X-Rays

Experiments made within the last few months on the reflection of X-rays from cleavage planes of crystals, based on the theory that natural cleavage planes approximate to that molecular degree of smoothness necessary for the reflection of extremely short wave-lengths, have proved successful, and for the first time definite and well-marked reflection of the X-rays has been secured. In a paper recently read before the Physical Society in London, Professors Barkla and Martyn presented the results of a further extension of this line of work. It is hardly necessary to remind our readers that the actual character of the X-rays has been a puzzle from the very beginning of experiments with them. They have been in turn supposed to be electromagnetic disturbances of enormously small wave-length, physical emission of some extraordinary and peculiar kind, and irregular pulses in the same medium which transmits other electromagnetic radiations but broken and devoid of anything like systematic periodicity.

The experiments seem to throw new light on the very puzzling phenomena and to afford a basis for a definite answer as to the identity of the X-rays and their relation to other forms of radiant energy. Barkla and Martyn made an investigation of the reflection of X-rays from a crystal of rock salt. Rock salt crystallizes in the cubic system; its cleavage planes are correspondingly simple, and it is unusually transparent to most of the known forms of radiation. The experiments were carried on chiefly at nearly grazing incidence, and it was definitely established that the reflection obeyed the ordinary laws which hold for electromagnetic radiations of visible wave-length. The reflected radiation had approximately the same penetrating power as the incident radiation and was fairly homogeneous after having traversed 5 mm of rock salt in the course of its reflections. Moreover, a definite system of interference fringes was established in the reflected ray owing to interference of the pencils reflected from equally spaced cleavage planes, the maxima observed by photographic methods corresponding to spectra of various orders. In fact, the cleavage planes might almost be said to serve in this case as an echelon grating. At all events, the system of interference fringes observed is thoroughly comprehensible on the theory that the radiations producing them are simple electromagnetic waves of extraordinary short wave-length.

Quantitative figures in a case of this kind must be accepted with some caution. In the particular instance before us the wave-length was figured on the theory that the crystal molecule in the cleavage plane was merely a simple molecule of sodium chloride and not a polymer. This hypothesis would lead to a minimum value for the wave-length, and collateral evidence makes it quite certain that one cannot assume such simplicity in the molecules of a solid. In a general way, the computation of the wave-length required to account for the interference phenomena observed led to a value of an order of magnitude no more than a few hundred-millionths of a millimeter; in other words, a few ten-thousandths, at the most, of the wave-length of visible light.

The shortest ultra-violet wave-lengths obtained by Schumann and by Lyman are at least a thousand times as long as those attributable to the X-rays from these latest experiments, and these shortest ultra-violet radiations are completely absorbed by a few millimeters of air and can be obtained only by working *in vacuo*. Below the Schumann region, therefore, there must exist, if the present experiments are confirmed, huge absorption bands in all gases yet investigated, rendering them opaque to short electromagnetic waves until a certain unknown inferior limit is reached, at which they again become transparent. Such absorption, however strange it seems at first thought, is not unknown within the wider range of radiation. Water, for instance, obstructs an enormous range of the longer wave-lengths, while beautifully transparent through the entire visible spectrum and far into the ultra-violet. A thin layer of asphaltum, on the other hand, shows opposite characteristics.

There is no great improbability *a priori* in the existence of a region of exceedingly short wave-lengths to which substances opaque to radiations of length commensurate to their molecular dimensions may be wonderfully transparent. If one looks upon absorption as a phenomenon of resonance, it should not exist for oscillation frequencies immensely greater or less than those that would produce resonance in structures of the size concerned. Extremely short radiations should traverse molecular structures as light waves traverse the "gauze ring" that surrounds Saturn. What lies in the region between the shortest radiations detected by Schumann and the X-rays which produce the interference fringes found by Barkla and Martyn remains yet to be discovered. This latest investigation opens a huge unknown region in which momentous discoveries are due. Meanwhile the work now done should be repeated and amplified to make sure that no secondary phenomena have been put in evidence and that no considerable factors of uncertainty lie in the determination of the wave-lengths. This much is certain, however, that we are on the road to a clearer understanding of the X-rays and to a glimpse at last of a new realm bearing perhaps the same relation to the electron that ordinary spectroscopy bears to the atom and the molecule.

The News of the Week

**Activities and Events in the Electrical Field—
Reports of Meetings—Commission Findings, Etc.**

Ontario Legislature Appropriates $2,500,000 for Extensions to Hydroelectric Systems

An appropriation of $2,500,000 for the Hydroelectric Power Commission has passed the Ontario Legislature. The Hon. Adam Beck, chairman of the commission, informed the House that the estimated expenditure for the year would be approximately $2,500,000, and that before the work now under way was completed $2,500,000 more would be spent. At least $250,000 will be required for new offices in Toronto with other incidentals. For extensions to the Niagara district $400,000 will be required, and for the Windsor extension $200,000. The transmission lines and equipment for this will cost $750,000; $150,000 will be expended on the Severn system, and $20,000 on the Port Arthur system. For the St. Lawrence system $250,000 will be required, for the Newmarket and the system north of Toronto $100,000, for the Cannington and Beaverton system $75,000, and for the Clinton service and the district about Goderich $250,000. The commission has decided that the extension of the Niagara system to Goderich offers more advantages than any other plan. It has also found it more economical to do its own construction work and has secured tenders for towers at $3.68 per 100 lb. of steel, against $4.30 for the same material put into towers when the first transmission line was built.

Scranton Railway Contracts for Central-Station Energy

The Scranton Railway Company, a subsidiary of the American Railways Company of Philadelphia, has signed a contract with the Scranton (Pa.) Electric Company for all electrical energy required by it for the operation of its street-railway system. The contract becomes effective Oct. 1 and is operative for twenty years. The load will range from 5000 kw to 6000 kw, and by the terms of the contract the Scranton Electric Company will take over the 1500-kw station of the railway company on lease and will also acquire a culm bank owned by the latter company. The 1500-kw station is comparatively new and contains a single Rice & Sargent engine and railway generator. The equipment is operated non-condensing and, the coal from the culm bank costing about 50 cents a ton in the bins, the cost of energy at the switchboard is about 8 or 9 mills. The old station of the railway company will be dismantled, but the 1500-kw station will be held in reserve and for use on peak loads.

The Scranton Electric Company will deliver the direct-current energy at four points and will make extensions to its system in order to take care of the load. Motor-generator sets will be installed with Tirrill regulators on the exciters of the synchronous motors so that the general power-factor of the system can be improved. The suburban station of the lighting company has been entirely rebuilt within the past year and a 10,000-kva unit is now being installed, the output of which will more than meet the demand occasioned by the railway load. The river station, which is ordinarily operated only during the steam-heating season, will be equipped with the motor-generators and converted into a combination generating and substation. Mr. Duncan T. Campbell is the general manager.

Ohio Utilities to Be Reimbursed for Flood Losses

Although no well-defined plan looking to the solution of the problem in detail has been formulated, it is the feeling of the authorities in Ohio that the utilities that have sustained great damage through the recent floods should be permitted to issue securities to cover the losses, instead of being compelled to make replacements out of surplus and future earnings. Governor Cox has been quoted as saying that the policy of the State should be one of sympathetic construction and that companies serving the public should be permitted to capitalize the replacements which they are forced to make through flood damages and spread the payment through a term of years. He is in favor of some plan that will cause a minimum of hardship. The attitude of the Public Service Commission is reflected by Commissioner O. H. Hughes, who has expressed a desire to help the utilities affected and who is of the opinion that if the laws of the State are not broad enough to give power in the premises to the commission, the Legislature now in session ought to give the proper authority to it. At the same time, in view of the blow which many of the properties have also received in the loss of present and future earnings, the commission, in his estimation, ought also to have the right to adjust rates to help make up the losses. This would have to be very carefully handled, however, he said, and the proposition will be entertained only in especially severe cases. Personally, Mr. Hughes favors a conservative policy at all times. He realizes that the reconstruction problem confronting the properties in Ohio at this time is very complex and should be solved in the light of reason.

A. I. E. E. Affairs

Upon recommendation of a special committee on organization of technical committees, the board of directors of the American Institute of Electrical Engineers at its meeting on April 9 authorized President Ralph D. Mershon to appoint a committee on marine electrical engineering. President Mershon was also authorized to appoint an Institute representative upon the advisory board of the National Conservation Congress.

The public policy committee recommended the passage of the following resolution for the guidance of the standards committee, the resolution having been suggested by the latter committee:

"Resolved, That is is the sense of this board that cooperation between the standards committee of the Institute and the standards committees of other national societies dealing with units and standards appertaining to or applicable in electrical engineering, or in the allied arts and sciences, is desirable, and it suggests that the standards committee shall take no action on any subject matter outside of the field of electrical or magnetic standardization, and within the field of the standards committee of another national society, before coming to an agreement with the standards committee of that society, provided that a reciprocal courtesy is extended by such standards committee of such society."

The special committee appointed in January to examine applications for transfer to the grades of member and fellow, filed under the special section of the constitution, re-

ported a list of twenty-seven applicants for transfer to the grade of fellow and eighty-six applicants for transfer to the grade of member, whose applications had been examined by the committee and found to comply with the requirements of the special section. The board of directors voted to transfer these 113 applicants.

Messrs. Maurice Coster, A. S. McAllister and Walter I. Slichter were appointed members of the board of examiners to succeed Messrs. H. S. Putnam, Cary T. Hutchinson and George Gibbs, resigned. Mr. Percy H. Thomas was made chairman.

First Electric Transmission Line from Sierras to Coast

Consumers of electrical energy in Santa Maria, Cal., expect to receive electricity generated in the Sierra Nevada Mountains, approximately 300 miles away, before the first of May. This is the first transmission line erected by the San Joaquin Light & Power Company for supplying electricity to towns on the coast.

Several months ago a franchise was granted to the generating company, and since that time the local generating stations at Santa Maria, Arroyo Grande and Paso Robles have been absorbed. Arrangements are now being made for changing over the motor and lighting load from the old plants to the new system. Besides being used for power and lighting purposes in business and residential districts, the electricity will be used for operating the irrigation wells on ranches.

Electrical service will be extended throughout the central portion of Santa Barbara County, it is understood. Mr. A. M. Frost, coast superintendent, has had charge of the recent development.

Rate Research Committee's Report

The application of rates and standard forms of contracts for electric service will be the features of the report of the rate research committee of the National Electric Light Association, the final copy for which was approved at a meeting of the committee in Chicago on April 10. This report will be submitted at the coming convention in June and will contain in addition a synopsis of the rates offered by eight or more companies in different parts of the country, together with the committee's idea of what is a proper form of contract. The results of the discussions brought out in the eight meetings held by the committee will also be incorporated. Mr. E. W. Lloyd, of the Commonwealth Edison Company of Chicago, is chairman of the committee.

Mr. Dunham to Develop Electrical Agriculture

Since his retirement from the presidency of the Hartford (Conn.) Electric Light Company, Mr. Austin C. Dunham has been actively engaged in investigations along diversified industrial and economic lines, and he has lately paid special attention to the possibilities of agriculture on a small scale by city wage-earners who live in the country except during working hours. Mr. Dunham has recently purchased a 90-acre tract of farming land at Newington, about 5 miles from Hartford and New Britain, and is planning to cut this up into about twenty small farms for purchase on a time basis by industrial workers in the city.

The intention is to provide each purchaser with a farming plant in first-class condition, and by the raising of diversified crops, hay and poultry and by dairying it is estimated that a farm costing about $4,000 can be paid for by the purchaser in from six to seven years. More than seventy-five applications have already been received, and Mr. Dunham requests that at this stage of the development no further inquiries be directed to him. The publicity already given to the scheme in the daily press has resulted in no little embarrassment through the flood of correspondence that has followed.

It is probable that when the work is fully started central-station service from the lines of the Hartford Electric Light Company will be utilized on these farms for irrigation, lighting, motor service and certain heating and cooking applications along the lines successfully practised on the Scandinavian peninsula. Full details of the work will be published in these columns upon the establishment of the detailed scheme, which is as yet only in a formative stage but is assured of the same thorough development which has accompanied Mr. Dunham's former investigations as head of the Hartford company.

N. E. L. A. Executive Committee Meeting

At the meeting of the executive committee of the National Electric Light Association on April 11 there were discussed, among other subjects, the question of flood relief, proposed changes in the constitution and by-laws, participation in the convention of the National Conservation Congress, arrangements for the Chicago convention, a report by Mr. W. F. Wells on the rating of apparatus, and the report of Mr. G. W. Elliott as master of transportation. Resolutions of congratulation upon the energy and promptness with which the supply of electricity was restored in Dayton, Ohio, were adopted and a copy was sent to President F. M. Tait.

Program of National District Heating Association Convention

The sessions of the fifth annual convention of the National Heating Association, Indianapolis, Ind., on May 27, 28 and 29, 1913, will be held in the Claypool Hotel. Among the papers to be presented are the following: "Hot-Water Heating for Residence Districts," by Mr. A. C. Rogers, Toledo Railways & Light Company, Toledo, Ohio; "Possibilities of Hot-Water Heating," by Mr. N. M. Argabrite, Indiana General Service Company, Elwood, Ind.; "District Heating on the Pacific Coast," by Mr. Charles F. Murphy, United Light & Power Company, San Francisco, Cal.; "Commission Control of Utilities," by Mr. D. L. Gaskill, secretary of the Ohio Electric Light Association; "Appraisal of Heating Properties," by Mr. Harold Almert, of H. M. Byllesby & Company, Chicago, Ill.; "Station Designs with Special Reference to Overload Capacities," by Mr. B. J. Denman, Edison Illuminating Company, Detroit, Mich.; "Is District Heating Profitable to the Central Station?" by Mr. C. J. Davidson, of Woodmansee & Davidson, Chicago, Ill., and "Operating Economies in Heating Large Factory Buildings," by Mr. Edward L. Wilder, assistant industrial engineer Rochester Railway & Light Company, Rochester, N. Y.

Boston Street-Lighting Situation

Electricity bids fair to capture most of the street-lighting service at Boston, according to present indications. Commissioner of Public Works L. K. Rourke favors electric service and is in receipt of tentative propositions from the Boston Consolidated Gas Company and the Boston Edison company which indicate that the city would save about $27,717 per year over the present cost of gas lighting in side streets, parks and alleys if tungsten lamps were installed on the Edison service. The present cost of lighting about 10,000 gas lamps on these minor thoroughfares under contract with the Rising Sun Street Lighting Company is $23.60 per lamp per year. The Consolidated company is

ready to enter a ten-year contract to operate these lamps at $21.50 per lamp per year, and the city would furnish only the equipment which it now maintains upon the streets. The Edison company offers a ten-year contract to furnish 60-cp lamps at $21.14 per lamp per year and 40-cp lamps at $18.33. The 40-cp tungstens give practically the same illumination as the upright gas-mantle lamps now in use, but with a better distribution of light. If the city should replace the gas lamps with tungstens under the Edison company's offer it would obtain at least one-third more light with the saving of nearly $70 per day over the present cost. Many gas lamps have been gradually replaced by tungstens in Boston, but at present Mayor Fitzgerald is withholding consent to the complete changing over of the equipment at a single stroke.

The Garage Problem

In a short paper read before the Chicago Section of the Electric Vehicle Association on April 8, Mr. R. Macrea, of the Commonwealth Edison Company, said that it is not strange that electric-garage service is not always what might be desired. Nevertheless, the question of garage service is of great importance to the electric-vehicle industry. While there are a number of good garages, there is an urgent need of improvement in most of them. The speaker made some humorous references to the exploits of "ready-made electric-vehicle experts." It has been asked if it would not be better if there were no public garages, but the answer must be in the negative, because what happens in private garages is often worse. The electric vehicle seldom fails; failure is caused by improper methods of operating.

This condition of affairs, in Mr. Macrea's opinion, appears to be due to lack of authoritative instructions on the subject. The manufacturers of electric automobiles provide little help in relation to operating. The remedy is an admission on the part of vehicle manufacturers that operating instructions are needed. It should not be thought that the term "kilowatt" is too academic for daily use. Instructions given by battery manufacturers are not sufficient, for they cannot be applied to all types of vehicles. The electric vehicle is still a long way from being foolproof, and the manufacturers should recognize this fact. Careful and minute instructions given to owners and garage keepers will do much to bring about an ideal standard of service.

Of the several garage men who took part in the discussion, one criticised the instructions of storage-battery manufacturers as not clear enough. Another laid blame on the generalities used by salesmen of electric automobiles in selling the cars. The mechanism and manner of operating should be explained carefully and in detail to the buyer. Salesmen should have a fair measure of technical knowledge. Another gentleman said that often the electric car is brought in late at night and the customer demands it early the next morning. With this situation there is a temptation to send out the car improperly charged. In fact, one garage owner said that the trouble is due largely to impatient and inconsiderate customers. This speaker said that his troubles were caused less by battery charging than by complaints, often unreasonable, that cars are not cleaned properly.

Mr. W. J. McDowell, of the General Vehicle Company, declared that the salesmen of that company endeavor to explain minutely the machine to the prospective customer. The salesmen find out first if the customer is prepared to handle an electric truck. The company has a service department and sends out inspectors who spend from two days to two weeks with the buyer or his employees, showing how to charge the batteries and how to make all mechanical adjustments. In addition, a book of printed instructions is left with the owner or operator of the truck. Both oral and printed instructions should be given when a truck is sold. The company has a force of inspectors who go around every thirty days inspecting trucks in service.

Mr. D. C. Arlington, of the Philadelphia Storage Battery Company, said that Mr. Macrea's contention referred particularly to manufacturers of pleasure vehicles; electric trucks are well taken care of. There are 2000 pleasure electric cars in Chicago, and the owners, or a large proportion of them, change from one garage to another at frequent intervals to get better service. The trouble is almost always the fault of the attention given to the battery and not of the battery itself.

Mr. McDowell added that one trouble was that customers often fail to follow instructions. A garage operator contended that sometimes the so-called inspection made for the manufacturers is only perfunctory. He added that in selling vehicles claims for long life for the batteries are frequently made that cannot be substantiated in practice. Furthermore, he asserted that sometimes the salesmen draw glowing pictures of a machine that will run two or three years without repairs. This is an exaggeration which does harm.

There was a brief but rather interesting discussion of the life of storage batteries in vehicle service. Mr. Arlington said that the batteries would last two years or more if they were not overworked. Mr. George H. Jones, of the Commonwealth Edison Company, suggested that it might be well to state the life of a vehicle battery in mileage. One garage man spoke of an electric car that was run nearly 1500 miles in a month, and another member told of one that had a record of 15,000 miles in eleven months with one set of batteries. He stated that it is the charging that wears out the battery, not the number of miles run.

Electron Theory of Metallic Conduction

In the last of the series of lectures before the American Institute of Electrical Engineers, delivered by Prof. E. P. Adams, of Princeton University, in New York on April 16, the subjects discussed were metallic conduction, the indication afforded regarding the structure of an atom by the study of radioactivity, optical phenomena in moving bodies, and the principle of relativity.

In outlining the application of the electron theory of metallic conduction Professor Adams said that all of our previous ideas of conductivity had been centered about Ohm's law and all known facts had been deduced from experimental work which followed this trend. In the electronic theory it is assumed that all metallic conductors contain free electrons which are not a part of any atom. The movement of these electrons in the metal is manifested as electric current, the direction of which is opposite that of the motion of the corpuscles. The particles are negatively charged and the flow of positive electricity must be in the opposite direction.

The relation of heat conductivity and electric conductivity was shown, and mathematical proof was submitted to substantiate the claim that both heat and electricity are carried in the metals by the free electrons. The ratio of thermal conductivity to electric conductivity has been proved mathematically to be a constant. These results have been verified by experimental work.

The application made by Professor Adams of the electronic theory to explain the action of an ordinary thermocouple proved very interesting. Each metal of the couple contains a different number of free electrons per unit of volume. As heat is applied the electronic pressure at the junction point becomes higher in one metal than in the other. To equalize this pressure the free electrons flow from one metal to the other. The manifestation of this circulation of charged particles is called electric current.

There are at the present time many things which have not received a satisfactory explanation by the application of this theory, but it is thought that with a better understanding of the structure of the atoms and the nature of the positive electric charge all of the discrepancies will disappear.

Professor Adams defined the principle of relativity as a negative hypothesis which denies the possibility of detecting absolute motion. Hence within a system there can be no detection of absolute motion. Only relative motion between the members of the system can be determined with surety.

In summing up the points which have been established by the study of radioactivity Professor Adams stated that it had been determined that each atom consists of a complex dynamic system and that different atoms vary in their degree of stability. The atoms which make up ordinary matter are relatively stable but those of the radioactive substances are constantly breaking down. An explanation of the ether and of the nature of the positive electrical charge are points upon which much work must yet be done.

President Ralph D. Mershon announced that the lectures on radioactivity would be published in the A. I. E. E. *Proceedings*, together with other matter which Professor Adams would have included in his talks had the period allotted to them been sufficient.

Electric-Heating Lecture at Boston

Mr. H. P. Ball, of the General Electric Company, Pittsfield, Mass., addressed the Boston Edison Company Section of the National Electric Light Association on April 15 upon recent progress in electric-heating design. Emphasis was laid upon the use of alloys in the later resistance elements and the point was made that such compositions as "michroma" and "calorite" have a resistance of from 611 ohms to 660 ohms per circular mil foot, while the older resistance materials were less than half as effective as heat producers. These newer materials also have high melting points, running from 1400 deg. to 1500 deg. C., and low coefficients of expansion. Mr. Ball also mentioned the possibilities of using "sheath-wire" resistance units in which the wire, surrounded by an insulating composition of aluminum oxide or similar material, is incased in a steel tube of low diameter which greatly facilitates the transmission of heat to the working plane of the heating device. With sheath-wire construction the temperature of the heating element can be run to from 800 deg. to 1000 deg. C., or practically at a white heat, while ordinary mica insulation dehydrates at not far from 700 deg. The future of industrial electric heating depends much upon this kind of material, which can be bent to a radius of ¼ in. and which will probably be on the market within a year.

Welfare Work at Boston

At a regular meeting of the Boston Edison Section of the N. E. L. A. on April 15 Mr. H. W. Moses, head of the company's Welfare Bureau, outlined the work of that branch of the organization and touched upon its experience in the past few months as affecting the largest central-station system in New England. Since Feb. 1 the bureau has conducted an employment office which has relieved department heads of many interviews with applicants for positions while giving these officials ample opportunity to "size up" desirable men when needed. At present the company is receiving about ninety applications per week. The employment division receives these during two hours each on Mondays, Wednesdays and Fridays, and applicants are classified into three groups—"good," "fair" and "poor"—the references of desirable men being looked up as required and a medical examination comparable to that of a life-insurance examiner being the final test prior to employment, assuming that an applicant has received favorable consideration from the department head.

Mr. Moses pointed out that the existing Massachusetts workmen's compensation act is working admirably in bringing employees and employers together. The Boston Edison company has disregarded the ten-dollar maximum weekly compensation provided in the law and pays full compensation from its disability payroll after the first fourteen days and for one-fourth the number of weeks the employee has been with the company to a maximum of 500 weeks. Under normal conditions the employee receives full pay during the first two weeks, unless he has exhausted his two weeks of sickness allowance in the year. Ninety-five per cent of the employees injured receive full compensation for the period of their injuries. An important branch of the work is handled by a safety committee, including representatives of the generating, steam, electrical, construction and other departments who meet weekly and discuss during luncheon the causes of accidents and the lessons of their prevention. Regular reports of each meeting are read from loose-leaf typewritten sheets, and every accident occurring on the system, whether to an employee or to an outsider, is filed in a separate folder and its details read at the meeting, with full discussion of causes and lines of preventive work. All accidents, however small, are reported and analyzed, and in addition to the work of the committee the company makes special studies of hazardous conditions with the idea of preventing casualties and warning against careless habits.

In closing, Mr. Moses outlined the work of the Industrial Credit Union of Boston, in which the company has two directors and about one-third the total membership. He described the system by which absent employees are visited on the day of their non-appearance by the company doctor or a representative of the Welfare Bureau, its effect in reducing the length of lay-offs and the insuring of adequate medical attention at the outset of illnesses and indispositions requiring a physician. Brief reference was also made to the new service buildings approaching completion on Massachusetts Avenue, Boston, where extensive provision is being made for welfare work as well as for company business.

Invention of Alternating-Current Magnet

A decision of the United States Circuit Court of Appeals as handed down by Judge C. J. Lacombe is of interest in establishing the invention of the alternating-current magnet now in successful use. The patents in suit were issued Nov. 24, 1903, and July 12, 1904, to Mr. David L. Lindquist, and they relate to the use of several coils symmetrically arranged around a central core, currents of different phase being used in the coils. The arrangement is such that the magnetic pull is exerted concentrically and never reduces to zero, and hence chattering is avoided. The original suit was brought by the Sundh Electric Company against the General Electric Company for alleged infringement. The claim by the latter was that the patents were invalid in view of the prior art and that Mr. Lindquist was not the original inventor. Judge Ray of the United States District Court, Northern District of New York, who rendered the lower court decision, held that Mr. Lindquist was the inventor and that the complainant was entitled to an injunction and an accounting. This decision has now been confirmed by the United States Circuit Court of Appeals. The chief design and operating features of both single-phase and polyphase magnets were outlined in a series of articles by Mr. Lindquist which appeared in our issues dated June 23, July 21 and Sept. 22, 1906.

Economics of Monopoly as Exemplified by Group-Control Electric Service

A picture that aroused enthusiasm was drawn by Mr. Samuel Insull, president of the Middle West Utilities Company and the Commonwealth Edison Company, in addressing the N. E. L. A. Company Section of the latter company in Chicago on April 15. The large audience embraced a number of visitors prominent in the financial, legal and administrative departments of the electric-service industry. Mr. Insull's subject was "The Economics of Monopoly in Public-Service Business," and his address was, in many respects, similar to the one on "The Production and Distribution of Energy," which he delivered before the Franklin Institute of Philadelphia on March 19. (See *Electrical World* of March 22.) It contained, however, some new material, or a different presentation of the facts bearing on this very important subject, as they appeal to the far-seeing mind of Mr. Insull.

The speaker began by declaring that monopoly is an economic necessity in the electric-service industry. Competition does not make for cheap energy; competition has been replaced by regulation to a very great extent. Regulation of monopoly by the community is more in accord with scientific methods than regulation by unrestrained competition. The great principles embodied in these statements have been borne in upon central-station men by experience, and men engaged in the electric-service industry have been and are being educated on the vital aspects of this question; it is not the public alone that needs to be educated. Electrical men have learned the lessons of load factor, of massing of production, and of diversity factor, in the hard school of experience. They have been trying recently to discover the economic laws governing the business of producing, distributing and selling electricity.

Mr. Insull devoted most of his remarks to the application of these general principles to the service of small communities through the group or unified system of control, such as is manifested by the modern operating syndicates. He showed the great advantage of supplying electrical energy for town light and power, for interurban and local railways, for drainage, mine operation, general manufacturing, farming operations, water pumping, ice-making, etc., from one source of supply. As in the Philadelphia lecture he drew many of his illustrations from Lake County, in northeastern Illinois, but he also made a number of estimates in relation to the possible electrification of the whole State of Illinois. One interesting statement in relation to Lake County (which is served by the Public Service Company of Northern Illinois) was that, taking the average of sixty-eight farms containing an average of 162 acres each, the income from them to the electric-service company was 60 cents per acre. Statistics were given contrasting the cost of giving various classes of service in rural communities from individual sources of supply with similar costs from unified control, greatly to the advantage of the latter. Various load diagrams were given showing, among other things, the great importance of the diversity factor.

Next the speaker used curves plotted on one sheet to show what might be the entire load of the State of Illinois, outside of Cook County, for the services named. It is estimated that the total maximum demand would be about 306,000 kw, but to meet this demand, owing to the diversity of the demand, it would be necessary to provide an installation of but 226,000 kw. This shows a saving of 80,000 kw in investment by utilizing the diversity factor in the manner possible with unified control. If we imagine Illinois, outside of Cook County, served from one source of electrical supply, or from several sources acting in unison, the total annual consumption is estimated at about 960,000,000 kw-hr. The largest item would be for the interurban and street railways, which would take 34.8 per cent; the next would be town lighting and power, taking 24.9 per cent; water pumping would require 13.4 per cent; farming 10.6 per cent, and so on. These figures, said Mr. Insull, show not only the economic necessity of monopoly in electric service, but they also present a very strong argument against the operation of small and scattered municipal plants, where the cost of producing energy is so high.

It is believed that the small central-station plants of Illinois have about 78 per cent of reserve capacity. This, of course, is very much greater than is necessary. If the various services, as town light and power, railway operation, farming, pumping, etc., mentioned as aggregating 306,000 kw, were operated from separate utilities with large modern plants the average reserve required would still be about 43 per cent. However, by combining the supply for all these requirements from one source the maximum demand of 226,000 kw required in that case would need only an additional reserve of about 20 per cent.

There are 326 communities, large and small, in the State of Illinois, outside of Cook County, supplied with twenty-four-hour electric service from uniform-control, group-service systems. Mr. Insull estimates that if all the requirements for energy in the whole State of Illinois were supplied through the medium of electricity, about 1,350,000 kw would be required. Nearly half of this would be for the steam railroads of the State. The saving in coal by operating the present steam railroads electrically, in connection with all the other energy needs of the state, would be tremendous, and is to be considered as an important factor in the possible conservation of natural resources.

In closing Mr. Insull said that unquestionably future years would see the entire territory from the Mississippi Valley to the Atlantic Ocean covered with a network of transmission and distribution lines with large generating stations at points where it is found economical to produce electrical energy, either in steam plants or by hydroelectric development. When cheap energy is widely available in this manner the effect on many of the sociological problems of modern life will be pronounced. It is not too much to expect that conditions of life and labor and of the upbringing of children away from the grime and distraction of cities will be materially affected by a wise system of distributing energy in rural communities. If the great system or systems of supplying electrical energy embrace the supply of energy to the railroads, the cost of commercial power will be so low that a manufacturer can settle in any rural community. The expense of transporting persons and goods will be much diminished. The possibilities of cheap power are very great, and Mr. Insull said, as his last word, that he saw no reason why these advantages should not be carried at least to every home in Illinois.

Jury Awards $500,000 Damages for Pole-Line Right-of-Way

Half a million dollars is the sum set by a jury in the federal court at Louisville, Ky., as a fair price to be paid by the Western Union Telegraph Company for the use of the right-of-way of the Louisville & Nashville Railroad Company in maintaining its telegraph service in the South. The verdict concludes the condemnation proceedings instituted by the telegraph company against the railroad, seeking to establish a fair price whereby it might secure the privilege desired. Mr. Milton H. Smith, president of the railroad company, declared in his testimony during the trial that $4,200,000 would about cover the damage sustained by the railroad company through the continued use of the plaintiff's lines along its right-of-way. The telegraph company considered $200,000 a fair and maximum price, although Mr. A. P. Humphrey, chief counsel for that corporation, placed the price at $3,500. Whether or not an appeal will be taken from this verdict has not been decided.

The proceedings involve the use of 1400 miles of right-of-way, from which the railroad company sought to oust the Western Union upon the expiration of its contract for telegraph service with that corporation in August, 1912.

Incorporation of Numerous Electric Companies in Pennsylvania

Pending public utilities legislation in the State of Pennsylvania has been the means of causing more incorporations of electric companies during the last month than the Secretary of the Commonwealth has known in years. Of the 291 manufacturing companies chartered, 173 obtained letters patent to furnish electricity or gas. In February the number of manufacturing companies chartered was 171, and in January 186 received letters patent. It is believed that a public utilities bill will be reported from the House committee within the next week, and as amended the measure will provide for seven commissioners to serve ten years. The object of the incorporation of so many electric companies prior to the adoption of a public utility measure is, of course, to enable the companies to float their securities before a commission exercises supervision of all issues of stocks, bonds, etc.

Report on Toronto Hydroelectric System

The annual report for the year ended Dec. 31, 1912, issued by the Toronto Hydro-Electric Commission shows that, after charging up $212,643.88 against interest on current operations, management and repairs and providing for sinking fund, the net profits for the year were $13,555.41. Together with this statement is one to the effect that next year the debt incurred last year in construction work will be wiped out and that there will undoubtedly be a decrease in the rates charged by the commission. The gross earnings of the commission for the year were $726,763.55. The cost of the electrical energy, operation, management and repairs for the year amounted to $500,564.26, leaving a balance of $226,199.29. Included in the expenses and charges which have been defrayed out of the year's income is the cost of getting new business, which, including the cost of advertising, was over $53,000. The sinking fund accruing to the construction period ended on Dec. 31, 1911, and carried from that date as against future profits, amounts to $50,985.49. Only $37,430.08 of this is carried forward as an obligation against future earnings. The estimated cost of the completed plant as finally decided upon by the commissioners was $4,500,000. Of this amount $3,734,911.33 was expended to the end of 1912, leaving an unexpended balance of over $765,000. The meters in use on Dec. 31, 1912, were 13,858, lamps in use 300,024, street lanterns 33,824, connected load 54,655 hp, peak load 17,198 hp. Toronto has a population of approximately 400,000 and the municipal system operates in competition with the Toronto Electric Light Company.

Merging of Louisville Utilities Halted

A citizens' suit has been brought against the Mayor of Louisville, other officials of the city, H. M. Byllesby & Company, of Chicago, and the local public-service corporations to prevent the merger of the local utilities according to the terms of ordinances recently passed by the Board of Aldermen and the Board of Councilmen permitting it. It is proposed to push the litigation to settlement as rapidly as possible, as negotiations looking toward the merger of all public-service corporations under Byllesby management in Louisville have progressed practically to the consummation of the project save for the interference of the citizens' suit. The chief contention of the plaintiffs is that rates higher than those specified in the merger ordinance may eventually be charged for gas and electricity in Louisville. Objection to the way in which the city seeks to waive its injunction forbidding the sale of the Kentucky Electric Company is also made, and it is charged that several sections of the merger ordinance violate the state constitution. The plaintiffs insist upon the right of free bidding for the merger franchise when it is offered for sale and declare that the Byllesby interests have received too great an advantage. The plans of the latter to organize a large holding company in Delaware for Louisville utilities are also attacked.

Additional Powers for New York Public Service Commissions Proposed

Three bills embodying the pledges made in the state platform of the Progressive party to give additional powers to the Public Service Commissions were introduced at Albany, N. Y., this week. The measures give powers to the commissions similar to those exercised by the Interstate Commerce Commission over rate questions. The measures provide that in any hearing by the commissions as to change in rates or service the burden of proof to justify the change shall be upon the company; that in any proceeding as to the reasonableness of any rate or the adequacy of any service the burden of full disclosure of all the facts as to such rate and service shall be upon the company, and when a schedule is filed changing a rate or a service afforded by a public utility corporation the commission may suspend the taking effect of such a schedule pending an investigation of the reasonableness and propriety of such change. Priority would be given to cases in which such suspension is granted. Another bill is designed to limit the powers of the courts in reviewing orders of the commissions to questions of law alone. It also abolishes the dilatory writ of certiorari as a means of reviewing orders of the commission, provides that no injunction against an order of the commission shall be granted except on notice to the commission, and definitely places on the party asserting the invalidity of an order of the commission the burden of proof to establish such invalidity. The justices of the Appellate Division of the Supreme Court have exclusive jurisdiction to restrain the taking effect of orders of the commission, but no order may be enjoined for more than ten days, except upon due hearing by the Appellate Division itself.

Pomona Voters Reject Rates Proposed by Socialists

The people of Pomona, Cal., early in April voted by a majority of about two to one against arbitrary reductions in the rates for gas and electricity charged by the company serving that city—the Southern California Edison Company. This pleasing and somewhat unusual result was due in large measure to the energetic newspaper publicity methods employed by the Edison company.

Pomona is a city of about 15,000 inhabitants not far from Los Angeles, in a region noted for its large production of oranges. The controversy over electric and gas rates was started by the socialists, who demanded that the City Council pass ordinances reducing not only these rates but the rates charged for water as well. The City Council said that it did not believe its members were qualified to pass upon the questions and suggested that the powers of regulation be transferred to the Railroad Commission of the State by popular vote. In California cities desiring to have their utilities regulated by the state commission must do so by referring the proposal to the voters. The socialists of Pomona were not satisfied with the answer of the

Council, so they drew up ordinances and presented them. The Council had the option of enacting the ordinances or referring them to the citizens and chose the latter course at the regular municipal election. The ordinances so summarily defeated, as recited above, proposed to make the gas rate 90 cents instead of $1, the base rate for electricity 5½ cents per kw-hr. instead of 8 cents, and a reduction of about 25 per cent in the water rates. The proposed rates were determined, apparently, without special investigation or knowledge as to whether they would produce a fair return upon the investment.

In the newspaper publicity campaign carried out by the Edison company through its publicity department, in charge of Mr. Charles H. Peirson, the company laid before the people sworn operating statements of the Pomona district for 1912; also figures bearing upon the investment values as appraised by Mr. Bion J. Arnold. The rate of return earned upon the investment was shown, contrasted with the prevailing rates upon which money could be borrowed in southern California. The entire proposition was discussed very frankly much as one business man would present a business proposition to another. The result amply justifies the general policies and methods pursued by the Southern California Edison Company and also indicates the fair-mindedness of a majority of the people in a part of California where the socialists are supposed to have obtained a considerable following.

Corporation Commission to Supervise Utilities in North Carolina

Electric light, water and gas companies other than those municipally owned or conducted and all persons, companies and corporations now or hereafter engaged in the business of furnishing electricity or gas in North Carolina have been placed under the supervision of the Corporation Commission, which now exercises control over railroad and other corporations. The Corporation Commission is to have full power and authority to fix, establish and regulate the rates or charges of such persons, companies or corporations, to make such investigations and orders and to establish and enforce rules and regulations, fines and penalties, as in the cases of railroads. When any such charges or rates are fixed or established by the commission they shall be deemed proper and any rate or charge made and collected by any such person or corporation other than that fixed by the commission shall be deemed unjust and unreasonable. The Corporation Commission is required to make reasonable and just rules and regulations, first, to prevent discrimination in furnishing electricity or gas, and, second, to prevent the giving, paying or receiving of any rebate or bonus, or the misleading or deceiving of the public in any manner as to real rates or charges for these commodities.

Illinois Public Utilities Bill

The public utilities bill backed by Governor Dunne and introduced in both branches of the General Assembly at Springfield, Ill., this week abolishes the railroad and warehouse commission and merges that department with the proposed public utilities commission. The following are the salient provisions of the measure: (1) A commission of five members, the salary of each to be $10,000 per annum; (2) abolition of the present State Railroad and Warehouse Commission; (3) provisions for appeals to the Circuit Courts and then the Supreme Court from all rulings of either the state commission or the local municipal commission; (4) the law to become operative in all cities of the State under 25,000 population upon its going into effect, leaving it optional with the cities of more than 25,000 population whether they will avail themselves of the enabling legislation and establish local commissions for the regulation of all utilities; (5) provisions whereby cities of more than 25,000 population which have adopted the commission method of dealing with the utilities may surrender their rights and come under the state commission control; (6) cities of more than 25,000 operating under a local commission to have jurisdiction only over the local utilities within municipal limits; (7) regulation of the issuance of all stocks, bonds and securities of all corporations, local utilities or otherwise, to belong to the state commission; (8) the act not to apply to municipally owned utilities in any city, such as water-works, gas and electric plants; (9) the powers of the commission to be made plenary and applicable to all public-service corporations of every kind and character in Illinois; (10) the commission to have authority to regulate the service of all public-service corporations with particular respect to schedules, quality of service and rates.

New Public Service Utilities Measure for Ohio

It is said that an entirely new public service bill will be presented to the Ohio Legislature in time for action before adjournment. Representative Mills, of Cleveland, is to report the substitute. It will provide for the physical valuation of properties, as originally advocated by Governor Cox, and it is believed that this will be left to the Interstate Commerce Commission, which is to make a valuation for the United States government. The bill will not include any changes in the present law relating to the indirect control of local companies by means of appeal to the Public Service Commission when the municipality and company fail to agree upon an extension or renewal of franchise. It is said that Mayor Baker of Cleveland and other home-rule advocates believe that the amendment to the constitution adopted last summer is self-operative and that under its provisions supervision over local public-service corporations will be denied without putting a special negation in the statute.

Oklahoma Utilities Bill

Although the Corporation Commission of Oklahoma has been in service several years, some doubt has been expressed concerning its powers over electric-lighting and railway, gas and water-supply companies, and the commission has therefore hesitated to give orders regarding rates and other subjects in connection with the operation of such plants. To define the commission's powers, a bill, prepared under the authorship of the commission's secretary, was recently passed by the Oklahoma Legislature and signed by the Governor.

This special statute gives the corporation commission "general supervision over all public utilities, with power to fix and establish rates and to prescribe rules, requirements and regulations affecting their services, operation and management and the conduct of their business." Although municipal plants of all kinds are explicitly excluded from coming under the provisions of the new law, the commission has with respect to privately owned utilities "full visitorial and inquisitorial power to examine such utilities and keep informed as to their general condition, their capitalization, rates, plants, equipments, apparatus and other property owned, leased, controlled or operated, the value of same, the management, conduct, operation, practices and service," with respect to the adequacy, security and accommodation afforded by their service as well as their compliance with the provisions of the act. The commission is also to have powers to specify accounting methods and to institute examinations, meter tests, etc.

The committee in the State Senate recommended insertion in the bill of an amendment providing that in case

the owner or operator of any public utility is engaged in carrying on any other business in connection with the operation of the utility the commission may require the cost of operation and gross revenues of such joint business to be kept as prescribed by the commission, so that the operating expenses and gross revenues of the public utility may be ascertained.

On the last day of the legislative session Senator Thomas, who introduced the bill, offered an amendment bringing municipal plants under the jurisdiction of the commission, but this measure failed by one vote. At the present special session the matter has been considered "of too minor importance" to justify bringing before the Legislature again at this time, although it is hoped to get the amendment passed two years hence. The municipal-plant provision was omitted in the original draft because the commission feared its insertion might arouse more opposition than actually appeared, and it did not want to put the whole bill in jeopardy on account of a single provision.

Organization of Missouri Public Service Commission

Governor Major of Missouri announced on April 13 that he had decided on four of the five members of the new Missouri Public Service Commission. These appointees are Mr. John M. Atkinson, of Doniphan, former Assistant Attorney-General; Mr. John Kennish, of Kansas City, former Supreme Court judge; Prof. H. B. Shaw, of Columbia, dean of the engineering department of the University of Missouri, and Mr. Frank A. Wightman, of Monett, who is a member of the present railroad commission. Two of the four gentlemen named are Democrats in politics, and two are Republicans. It is said that the fifth man will be a Democrat. Mr. E. J. Bean, of De Soto, is named as the probable attorney for the commission. It is reported that Mr. Thomas M. Bradbury, until recently secretary of the State Board of Railroad and Warehouse Commissioners, which went out of existence on April 15, will be appointed clerk of the new commission. The salary of each commissioner is $5,500, those of the attorney and clerk being $4,500 and $3,600 respectively. The commission will establish headquarters in the temporary capitol at Jefferson City. It is said that Kansas City will probably make the first demands upon the services of the commission, as there is trouble there with the street-railway company and the gas company. The Missouri & Kansas Telephone Company may make an application for authority to raise its rates.

Public Service Commission News

Massachusetts Commission

Chairman Barker of the Gas and Electric Light Commission appeared before the legislative committee on public lighting on Tuesday and advocated that all companies producing electricity for any purpose whatever be placed under the supervision and regulation of the board. He pointed out that the time is near when the sale of electricity for lighting will be but a minor part of the business of energy distribution and stated that the proposed codification of the laws would do much to clarify the existing statutes and give the commission uniform powers over all electric-service companies. Chairman Barker also said that the proposed extension of the board's authority to cover such companies as those selling hydroelectric power on a large scale would not hamper their prosperity but would tend to give the securities of such concerns additional value on account of the added stability accompanying proper regulation.

New York Commissions

Most of the large railroad companies centering in New York City and the manufacturers and distributers of electricity were represented at a hearing before the Public Service Commission for the First District on a resolution adopted by the commission for the drawing up of a code of rules to insure public safety and safety to employees in all departments of companies either producing or operating with electricity. A code of thirty-one rules, drawn up by the electrical engineer for the Public Service Commission, was submitted and the representatives present were asked to submit a series of rules which would be applicable in their respective cases.

To facilitate the movement of coal between its plant and the Long Island Railroad Company, the East Hampton Electric Light Company intends to construct a switch track and has filed an application with the Public Service Commission for the Second District for permission to issue $2,500 of bonds and apply the proceeds toward defraying the cost of this construction. At the present time the lighting company is obliged to haul its coal by wagons between these points.

Hydro-Electric Power Commission of Ontario

The report of the Hydro-Electric Power Commission of Ontario submitted to the Ontario Legislature at its present session contains some 250 pages and gives a complete record of the work of every branch of the undertaking—construction, distribution, municipal advising and hydraulic investigating—together with a detailed statement of expenditures. The total capital expenditure, as announced by the chairman two months ago, was to the end of the year $4,579,829, of which $4,158,829 covered the transmission lines and transformer stations of the Niagara system. The provincial expenditure during the year was $123,751 on current account, of which $50,458 was for engineering assistance to municipalities, etc., and the capital expenditure of the Province was $46,932. The figures as to operation, cost and sale of energy are illustrated in the report by charts showing the monthly consumption of electricity in each of the municipalities in the system. A detailed report is given on the numerous transformer stations, and the progress of work under the municipal department is covered with respect to each municipality that has applied for advice. The report gives the result of twelve hydraulic investigations to determine whether electricity can be developed in sufficient quantity.

Current News Notes

Damage by Flood to Telegraph System.—Mr. John Fitzpatrick, district commercial superintendent of the Western Union Telegraph Company in Chicago, is reported to have said that owing to the Ohio and Indiana floods about 100 miles of cable, 300 miles of wire and 2000 men were used in making temporary repairs. It is estimated that the damage to the property of the Western Union company will amount to over $250,000.

* * *

Recovery of Telephones.—A reminder of the severity of flood conditions in Dayton is contained in an advertisement of the Home Telephone Company of that city printed in a local paper not long after the water had subsided. "Subscribers of the Home Telephone Company," says this appeal, "will confer a favor and greatly facilitate the restoration of telephone service by preserving the telephone instruments in residences, stores or offices. Wherever telephones have been wrecked and torn from their positions we shall greatly appreciate it if you will be good enough to put them aside; our men, with proper credentials, will call for them at the earliest possible moment. Or, if it is convenient for our subscribers or other persons to do so, we shall be very grateful if they will bring such instruments to our office."

Wireless in Flood Region.—A wireless-telegraph system for flood relief work is to be opened at Vicksburg, Miss., by the United States Signal Corps. Wireless stations will be located in remote sections which are liable to be cut off from other communication by high water.

* * *

Public Service Commission, Second District, New York, to Retain Control of Telegraph and Telephone Companies.—The Fitzgerald bill transferring the jurisdiction over telephone and telegraph companies from the Public Service Commission of the Second District to the Commission of the First District, New York, was defeated in the Senate on April 15.

* * *

Students Aid in Rebuilding Hamilton (Ohio) Plant.—The University of Cincinnati shortly after the flood detailed Prof. A. Wilson and six senior students of the electrical course to go to Hamilton, Ohio, and assist in the rehabilitation of the power plant and water-works there. The students rendered valuable assistance in getting both systems in operation again within the week.

* * *

Report of Railroad Commission of Georgia.—The Railroad Commission of Georgia has issued its 1912 report on the street railway, gas and electric corporations operating in the State for the year 1912. The statements of forty-eight public utilities are included, and of these only four show a deficit. The companies' gross earnings for the year were $9,998,490, against $8,868,223 in 1911.

* * *

Federal Department of Public Works Proposed.—At the National Drainage Congress in St. Louis on April 10 Mr. Isham Randolph, the well-known engineer of Chicago, suggested that the national government needs a department of public works, the head of which should have a seat in the President's Cabinet. Mr. Randolph holds that the regulation of the flood waters is a federal duty and that this duty could be carried out by the government department which he suggested.

* * *

Telephone Company Ousted.—The controversy over rates assessed against mutual telephone companies in Henry County, Ohio, by the Napoleon Telephone Company, and dissatisfaction with the latter's service in Napoleon, culminated in the passage of an ordinance terminating the company's franchise. The ordinance was classed as an emergency measure and will go into effect on May 13. The telephone company was organized a year ago and has about 1000 telephones besides exchanges in six villages in Henry County.

* * *

Electrification of Railway Terminals Again Under Discussion in Chicago.—The electrification of the railroad terminals of Chicago is a subject that has been up for discussion in that city intermittently for the last ten years or more. A new City Council came into office on April 14, and one of its first acts was consideration of an ordinance introduced by Alderman Long requiring all railroad companies to operate their cars by power other than that of steam, or in such a manner as not to produce smoke or noxious gases. This ordinance set July 1, 1914, as the date for the electrification to be completed. It was referred to a new aldermanic committee known as that on railway terminals, of which Alderman Geiger is chairman.

* * *

SOCIETY MEETINGS

Coming Rejuvenations.—A rejuvenation of the Jovian Order will be held on April 24 at Waterloo, Ia., during the convention of the Iowa Electrical Association. The next rejuvenation in St. Louis will be held on May 23.

Chicago Section of Electric Vehicle Association.—The annual meeting and banquet of the Chicago Section of the Electric Vehicle Association will be held on the evening of May 6. Officers for the ensuing year will be elected at that time.

* * *

Jovian Activity in Philadelphia.—Following a luncheon which drew a large number of Jovians to the Bingham Hotel, Philadelphia, on Thursday of last week, a dinner and rejuvenation were held at the Continental Hotel on Friday evening, April 11. The arrangements were under the supervision of Statesman J. Crawford Bartlett and included an enthusiastic reception to Jupiter Frank E. Watts.

* * *

Spring Meeting of New England Section, N. E. L. A.—In place of the usual spring convention, the executive committee of the New England Section of the National Electric Light Association has voted to hold an informal dinner and "get together" meeting at the American House, Boston, Mass., on the evening of May 2. The dinner will take place at 6.30 p. m., after which two addresses will be given by speakers not yet announced. Miss O. A. Bursiel, 149 Tremont Street, Boston, Mass., is secretary of the New England Section.

* * *

Jovian Rejuvenation at Chicago.—At a rejuvenation held April 15 at the Hotel Sherman, Chicago, 67 candidates were initiated into the Jovian Order. Statesman G. C. Richards had charge of the affair, the attendance at which numbered 162. At the luncheon following the ceremonies Mr. A. A. Gray officiated, and Mr. Sam A. Hobson, past Jupiter, spoke. A cabaret show closed the evening's entertainment. Statesman Richards has announced the plans for the Chicago rejuvenation to be held in connection with the National Electric Light Association convention in June, when the Chicago Jovians expect to entertain 2000 members of the order. The ballroom and casino at "White City" have been reserved for the occasion.

* * *

Organization of Peoria Electric Club.—At a meeting of electrical men of Peoria, Ill., held on April 5, the Peoria Electric Club was organized with the following officers: President, Mr. C. A. Hoppen, Peoria Gas & Electric Company; vice-president, Mr. W. E. Wolgamott, city electrician; secretary, Mr. E. H. Joseph, Mills Electric Company; treasurer, Mr. Charles E. Stapp, Stapp Electric Company; executive committee, Messrs. H. J. Vance, Illinois Traction System; Louis B. Van Nuys, Central Electric Company of Peoria; T. E. Keltner, Central Union Telephone Company, and T. D. Buckwell, Peoria Gas & Electric Company. The initial membership consists of thirty of the representative electrical men of Peoria. Meetings will be held on the first and third Saturdays of each month at the Jefferson Hotel.

* * *

Program of Iowa Electrical Convention.—The thirteenth annual convention of the Iowa Electrical Association (now affiliated with the National Electric Light Association) will be held in Waterloo, Ia., April 23 and 24. The morning session of April 23 will be devoted to routine business. In the afternoon there will be papers by Mr. E. M. Walker, of Dubuque, on "Welfare Work," and by Mr. C. W. Drake, of Pittsburgh, on "Off-Peak Possibilities." In the evening there will be a banquet and social entertainment. Two sessions will be held on Thursday, and papers are scheduled as follows: "Feeder and Voltage Regulation," Mr. V. A. Hain, Chicago; "Rural Line Extensions," Mr. John M. Drabelle, Cedar Rapids; "High-Tension Transmission Lines," Mr. H. W. Garner, Oskaloosa; "Operation of High-Tension Lines," Mr. Rufus Lee, Clarina; "Keokuk Hydroelectric Development," Mr. Dexter P. Cooper, Keokuk.

Central-Station Practice at Cambridge, Mass.—I

Installation of low-pressure turbo-units in extending the generating facilities of original reciprocating-engine plant—Test of 625-kw low-pressure turbine

ONE of the most progressive central-station organizations in New England is the Cambridge (Mass.) Electric Light Company, which serves a total population of about 115,000 persons in the municipalities of Cambridge and Belmont, forming one of the most important groups of consumers of electric service in the Greater Boston district.

As the seat of Harvard University and Radcliffe College and the future home of the Massachusetts Institute of Technology, the city of Cambridge is known throughout the educational world as an intellectual capital; as the possessor of a historic past the community is one of the most noted tourist centers of America, and as a center of diversified manufactures it furnishes one of the most varied outputs of commodities to be found in any city of the same size in the country. Its intimate connection with Boston proper, which lies on the opposite side of the Charles River and which looks upon the "University City" as one of the nearest of its residential suburbs, is a striking feature of its social and industrial life.

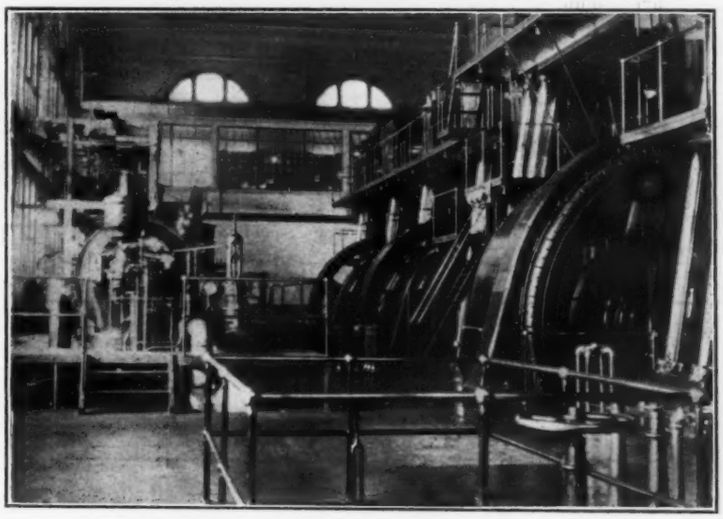


FIG. 1—ENGINE AND TURBINE ROOM OF CAMBRIDGE ELECTRIC LIGHT COMPANY

The central-station service of Cambridge is correspondingly varied. At present there are 314 manufacturing establishments in the city, employing 21,000 persons and having a yearly payroll of about $11,500,000. The value of the city's manufactured products is now about $60,000,000 per annum and there are 207 different lines of manufacturing carried on in the town. The assessed valuation is now $114,000,000 and the value of unassessed property is $40,000,000.

History of Cambridge Plant

The Cambridge Electric Light Company was incorporated in 1886, with a capital of $60,000, as a result of the interest awakened in the suburbs of Boston by the greater security to life and property in that city afforded by street arc lighting. By the fall of 1887 the company was supplying seventy-seven public and seven commercial arc lamps and 847 incandescent lamps. By Jan. 1, 1913, the total connected load of the system had risen to 93,648 50-watt equivalents in carbon lamps, 18,463 40-watt equivalents in tungstens, 8752 hp in electric motors and 130 kw in energy-consuming appliances of small individual capacity, there being 306 motor customers and 3280 lighting customers. The capital stock of the Cambridge Electric Light Company on the latter date was $850,000.

The first station of the company was a small plant near the West Boston Bridge, on Main Street. Here were installed two 100-hp boilers, and at first a 250-hp Buckeye twin engine. Later a 100-hp Armington & Sims engine and a 90-hp New York Safety engine were added, making a total engine capacity of 440 hp. The method of lighting used was known as the New England Weston system and proved unsatisfactory. The foundations of the building were unsuited even for the small engines.

In 1887 the company purchased a tract of land adjoining the Charles River on Western Avenue and erected a brick station at a total cost of about $200,000. This was occupied in the fall of 1888. It contained at first four 125-hp horizontal-return tubular boilers, to which were later added five more of the same type. The engines were moved up from the old plant and were installed in the new plant with three fifty-lamp Thomson-Houston dynamos, three forty-five lamp dynamos, a 40-hp generator and two dynamos of 1000 and 500 lamps rating. From time to time these engines were changed to the tandem-compound, condensing type, with high-speed operation, and dynamos were added until there were seven engines with a total capacity of 2050 hp, every available corner being filled with machinery. All of these engines were directly belted to their dynamos, a notable advance in practice for those days.

In 1887 the company furnished the energy for storage batteries with which the local street railway organization experimented in connection with car propulsion. These experiments were unsatisfactory, but in 1889 the newly invented overhead trolley system was installed on the horse-car line from Bowdoin Square, Boston, to Arlington, via Harvard Square, and the Cambridge Electric Light Company furnished the energy for this service, which was the first successful line of electric cars operated in the vicinity of Boston. In 1892, however, the company ceased to furnish power for street-railway uses.

Construction of Present Plant

By 1898 it became evident that the company would soon have to build a new station, and the present building was erected according to the plans of the engineering firm of Sheaff & Jaastad, at that time in practice in Boston. The building faces the Charles River Parkway and, as shown by the accompanying illustration, was designed to harmonize with the surroundings.

The plant is a brick and steel structure with pink granite

foundations and is 100 ft. by 165 ft. in plan, its height being 85 ft. At present the space between the station and the river is occupied by a coal pocket. Eventually the company's coal-storage facilities will be located upon land bordering Broad Canal, and the space between the station and the river will be provided with a lawn and shrubbery.

Rating of Plant

It is noteworthy that the present installation of engines and low-pressure turbines, the latter representing one of the first applications of its kind in central-station practice in the East, has been made without enlarging the building from its original dimensions. The plant to-day contains eight Babcock & Wilcox boilers, each of 440-hp rating; two 600-kw, one 1500-kw and one 2000-kw vertical cross-compound condensing engine-driven unit, and two low-pressure turbo-generators of 625-kw and 1500-kw rating, the smaller outfit being connected to the exhaust of one of the 600-kw sets and the larger to the 1500-kw engine exhaust. The total rating of the station is 6825 kw.

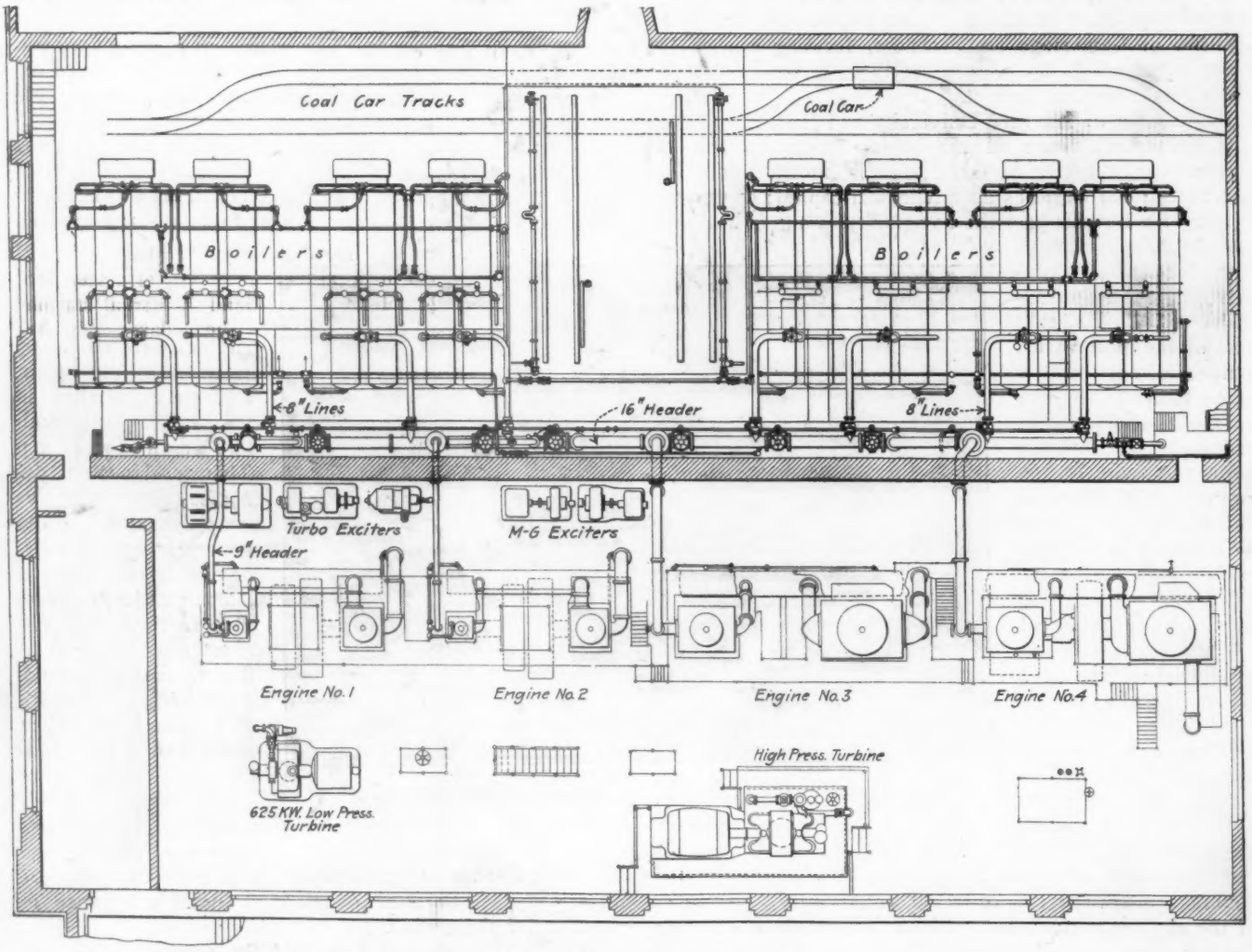


FIG. 2—PLAN VIEW OF STATION

Coal is delivered at the station by barges and is handled by a steam crane which unloads into a storage area holding about 8000 tons. From the coal pocket the fuel is transported, over a track of 20-in. gage, to the boiler room, in hand-cars of 2300-lb. capacity, twenty-four of these cars being in service. The boilers are installed in four batteries in a single row facing a firing aisle about 13 ft. wide, two narrow-gage tracks being carried past the batteries.

The tracks are provided with cross-overs and a set of platform scales upon which all fuel is weighed and then hand-fired into the hoppers of an installation of Taylor three-retort stokers recently added to the station equipment. The coal cars are usually filled to a level about 12 in. above the top and are passed through the boiler room so far as possible without doubling back upon their paths except when moved out for refilling. About 60 tons of bituminous coal are at present burned daily in the plant, the output at the switchboard being about 40,000 kw-hr.

Under the boiler-room floor and below the grates an ash tunnel 8 ft. wide extends the full length of the building. On this narrow-gage track runs an ash car. Ashes are discharged through hoppers into the car and raised in the latter on a hydraulic elevator to the ground level, whence teams remove them to dumps. All ashes are weighed before being disposed of outside the building. Draft for the stoker installation is provided by two 75-hp motor-driven fans in the boiler room. Natural draft is furnished by a brick chimney 255.5 ft. high and 9 ft. in inside diameter carried on a solid concrete foundation 25 ft. square at the top, 44 ft. square at the bottom and 14 ft. deep.

Boiler Auxiliary Equipment

Between the adjacent pairs of boiler batteries in the center of the boiler room are installed two Green fuel economizers with motor-driven tube scrapers. The chimney is located outside the building on the side of the boiler room away from the engines, and a direct by-pass is provided around the economizers. In the space at the ends of the boiler batteries under the chimney flues are two Blake 65 in. by 8-in. by 12-in. duplex outside-packed feed pumps, each capable of providing water for 8000 hp of boilers.

The pumps draw water from the city mains through a receiving tank in the basement which also holds water from the turbine hot-wells. City water, used mainly for make-up service, is taken at about 40 lb. pressure. After the water leaves the feed tank it passes through the heaters, which

are all of the American "Whitlock" type, and also through the economizer tubes, into the boilers. In case of accident or repairs to either economizer or to any of the heaters the equipment can be cut out and the water delivered more or less directly to the boilers from the pumps. The heaters include a 2000-hp outfit in the boiler room, which receives the exhaust from the auxiliaries in the usual manner, and

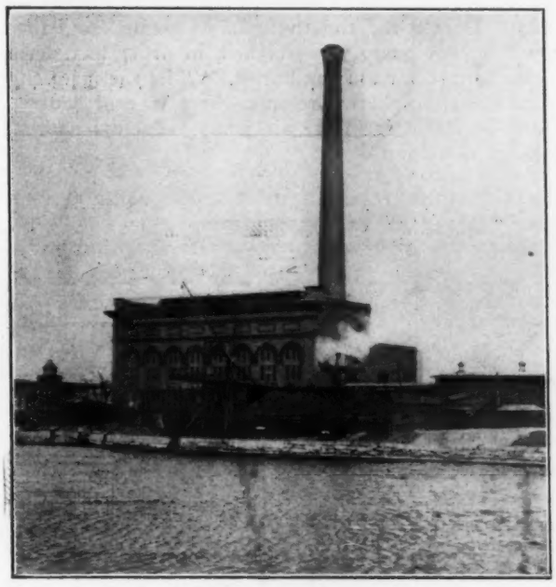


FIG. 3—STATION, SHOWING MEANS OF HANDLING COAL

two engine exhaust heaters of 500-hp and 2000-hp rating through which the feed water is passed on its way to the boilers.

The boilers are equipped with superheaters and are operated at a normal steam pressure of 165 lb., the superheat being about 150 deg. Fahr. They are piped with water-column alarms arranged to sound a whistle in case the water level runs low or high. The furnaces are about 7 ft. by 9 ft., and the stokers are operated by two 10-hp Sturtevant engines. In the year ended June 30, 1912, the plant consumed 15,154 tons of bituminous coal costing $4.06 per ton delivered at the stokers. The cost of unloading the fuel at the barges and handling in the cars above mentioned was 32 cents per ton. A Spencer automatic damper regulator installation is located in the boiler room, which regulates within 2 lb. above or below normal. A 5-ton hand-operated crane serves the boiler room.

From each boiler an 8-in. pipe carries the steam to a 16-in. cast-gun-metal header running along the rear wall above the boilers. At the bend where each pipe leaves the boiler is an 8-in. valve and the header is also provided with sectionalizing valves. Any 10 ft. of pipe may thus be cut out of service. From the main the steam is led to a receiver for each engine. These act as steam reservoirs and facilitate the maintenance of uniform pressure at the throttle. At the bottom of each receiver is a drip pipe connected with a Holly return system in the basement which delivers high-pressure condensation back into the boilers. All the connections in the steam-piping system are by Van Stone joints with copper gaskets. The piping is insulated against heat losses by 1.5-in. magnesia covering. The total height of the boiler room is about 60 ft., and a passageway about 10 ft. wide is provided at the rear to facilitate inspection and repairs.

Engine Room

The engine equipment consists of four McIntosh & Seymour vertical cross-compound condensing outfits, each direct-connected to a revolving field General Electric 60-cycle, 2300-volt, three-phase alternator running at 120 r.p.m. Two 600-kw units are installed, one exhausting into a 625-kw General Electric low-pressure turbine and the other into a Blake jet condenser. The 1500-kw set above mentioned exhausts into a low-pressure turbine of the Parsons type, rated at 1500 kw. The 2000-kw set exhausts into a Blake jet condenser. Surface condensers are used on each of the low-pressure turbines, the smaller installation being provided with Worthington apparatus and the larger one with Westinghouse equipment.

The low-pressure turbines drive alternators delivering 60-cycle energy at 2300 volts. Each engine set is provided with a flywheel in addition to the revolving-field structure. The cylinder dimensions of the two smaller engines are 18 in. by 38 in. by 42 in.; of the 1500-kw set, 33 in. by 56 in. by 48 in., and of the 2000-kw set, 36 in. by 72 in. by 48 in. Each low-pressure turbine is provided with a live-steam supply pipe and an automatic valve which admit steam from the boilers in case of an insufficient supply from the associated engine.

Condensing water is drawn from the Charles River for all the units. A concrete intake 4.5 ft. in diameter delivers the river water into a concrete well 10 ft. in diameter and 25 ft. deep, from which three suction pipes, 14 in., 16 in. and 20 in. in diameter, lead to the condensers. The condensers of the two smaller engine sets are supplied by the 16-in. pipe, the 14-in. pipe serving the jet condenser of the largest engine. An 8-in. auxiliary line supplies water for fire service, bearing-cooling purposes and incidental station uses. Although the Charles River has been dammed at its outlet for several years and is consequently no longer a tidewater stream, its waters have not as yet become fit for boiler feeding in Cambridge.

All auxiliaries in the station are in general piped to deliver their exhausts into the low-pressure turbine installation, and in the future it is planned to cross-connect the auxiliary exhaust piping so that the discharge from any

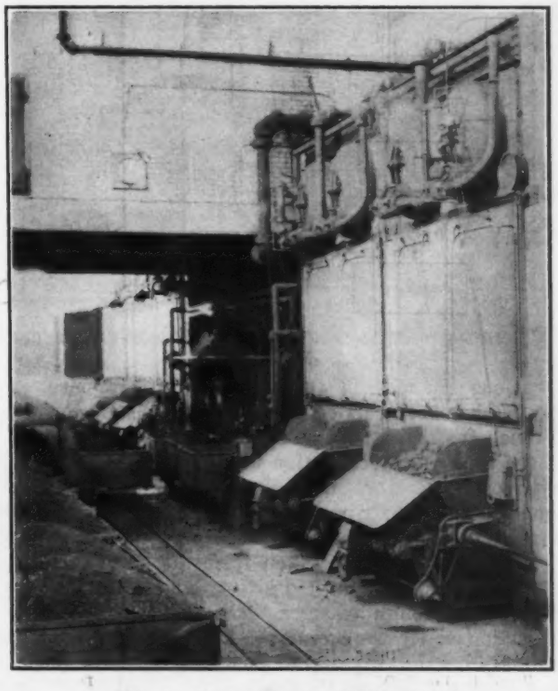


FIG. 4—COAL CARS IN BOILER ROOM

such apparatus can be turned into either low-pressure turbine, as well as into the main feed-water heater as at present. All the engines and turbines are piped to a free exhaust header discharging out of doors at the roof level. The engines may be exhausted into the feed-water heater instead of into their related low-pressure turbines, if desired.

Adoption of Low-Pressure Turbine

At this point a résumé of the more important points involved in the adoption of the low-pressure turbine installation may properly be included. The initial investigation was conducted about four years ago by Prof. I. N. Hollis of Harvard University, consulting engineer for the Cambridge Electric Light Company, and the selection of low-pressure equipment and such tests as have thus far been made upon it have been in his immediate charge. The discussion given below and the test data printed are obtained from reports submitted by Professor Hollis to the company and from a paper by Mr. Walter R. Eaton, electrical engineer of the company, before the New England Section of the National Electric Light Association. The engineering work in connection with the installation of the low-pressure turbines and piping within the station, and including various changes in the switchboard equipment and apparatus, has been carried out with the assistance of Hollis, French & Allen Hubbard, engineers, of Boston.

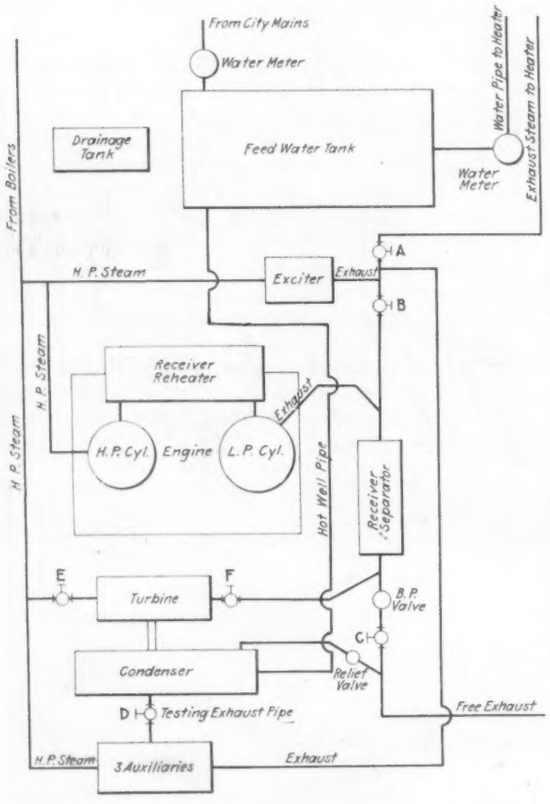


FIG. 5—PIPING DIAGRAM FOR 625-KW LOW-PRESSURE TURBINE

At the time the investigation began there were four engine-driven generators in the station, and these were designed to run with a possible overload of 50 per cent for a short time. This gave an overload output of about 6750 kw. The steam was then taken from the boilers at about 145 lb. pressure and exhausted into ordinary jet condensers after passing through a heater. The condensed steam and the injection water were removed from the condensers by an ordinary bucket air pump in each case. The proposition at that time was to run the engines on about 15 lb. back pressure, and to utilize this in driving a low-pressure turbine installation, this amounting to the making of the engines so connected into triple-expansion units with their third cylinders replaced by the turbines.

Plan of Preliminary Tests

In order to determine with fair accuracy the possible economy with this combination, one of the 600-kw sets was run under three back pressures; first, with as great a vacuum as possible by speeding up the air pump; second, with a very moderate vacuum, and, third, at atmosphere. It was not possible to weigh the feed water used under these different conditions. Enough data were available from a previous test to determine with close accuracy the amount of steam used per indicated hp-hour. This was done, and a combined card made of the third case in order to figure out the amount of energy available for the steam turbine. During the run the exhaust steam from the air pump and feed pump was weighed, in order to determine the expenditure for the auxiliaries. While the main engine was on the atmospheric pressure, there was, of course, no exhaust of steam from the air pump. Table I shows the results of these tests.

TABLE I—ENGINE TESTS UNDER VARIOUS BACK PRESSURES, CAMBRIDGE, MASS.

	Back Pressure (lb. per sq. in. absolute)		
	1.5	3.3	16
Indicated hp	803	836	1001
Kw load at generator	540	563	673
Lb. steam per ind. hp-hr.	13.21	14.10	21.58
Lb. steam per kw-hr.	19.64	20.96	32.07
Lb. steam per ind. hp-hr., including air and feed pump	14.97	14.96	21.94
Lb. steam per kw-hr., including air and feed pump	22.26	22.24	32.60

The table shows that with the greatest vacuum—27 in.—the indicated power developed by the engine was 803 hp; with the vacuum of 23.3 in. the indicated hp was 836, and with atmospheric exhaust, amounting to 16 lb. back pressure, it was 1001. The paradoxical character of these figures is explained by the fact that in this case the cut-off naturally responded to the greater demand for steam, and consequently the power was increased in proportion to the demand at the switchboard. Further, the load was purposely increased during the atmospheric exhaust in order to show that it was entirely feasible to run the engine with an overload. There was no gain by increasing the vacuum beyond 23 in. or 24 in. with the station as then arranged, as the amount of steam used in the auxiliaries offset the gain in the engine.

The steam per kilowatt-hour as given represents practically the total outlay of steam per unit of output for the station, as shown in the table for the three conditions of back pressure.

The greatest amount of power was, then, 1001 indicated hp, or 673 kw at the switchboard, obtained from one of the smaller units. A combined card was made, in order to enable the power available for a low-pressure turbine to be determined in case the steam were turned into the nozzles of such a machine instead of being thrown away into the air. This power amounted to 1069 hp, which, added to the output from the engine, gave a total of 2070 available indicated hp, or 1392 kw, as against the normal output of 500 kw for which the engine was designed.

Investigation showed that this great increase in power could be obtained without any further increase in steam consumption than would be obtained with the main engine exhausting into the atmosphere. It was estimated that the amount of steam per kilowatt-hour would be 15.51 lb. excluding auxiliaries, or 16.77 lb. including the latter, the allowance for auxiliaries being the maximum obtained on a run for a vacuum of 27 in. These preliminary studies indicated a saving of 5.47 lb. per kilowatt-hour in one unit by the use of a low-pressure turbine, or a gain of 24.6 per cent in economy of operation.

Installation of 625-kw Turbine

In making the installation the small feed-water heater into which the 600-kw engine set originally exhausted was replaced by a Cochrane separator and there was also put in a 625-kw Curtis horizontal mixed-pressure turbine running at 1800 r.p.m. and exhausting through a 28-in. Wainwright expansion joint into a Worthington surface condenser. The turbine stands upon the floor with no special foundation except a reinforcement of the floor I-beams by two vertical columns in the basement. The condenser has 2750 sq. ft. of cooling surface. It is supported above the basement floor and directly under the turbine, and is equipped with an inner cooler for drying air and a hot-well from which the condensation is pumped. The circulating pump is a Worthington volute equipment having a capacity of 2400 gal. per minute and it is driven by a 6-in. by 6-in. Blake engine running normally at 240 r.p.m. After placing this pump in service so much foreign matter reached the condenser tubes from the river that a twin strainer was installed in the intake.

The outboard-discharge pipe is about 150 ft. long and 12 in. in diameter. Its lower end is water-sealed by being carried below the river level, thus giving a siphon system of circulation. The wet-vacuum pump is a 2-in. two-stage turbine hot-well pump, driven by a 4-hp Terry steam turbine running 1500 r.p.m. The reclaimed water from the hot-well is sent to a feed tank in the basement, and, as outlined above, this tank acts as a reservoir from which all the water evaporated by the boilers is pumped through a hot-water meter. The city water used in the make-up is fed into the tank through a separate meter, so that the amount of water required and saved can be determined at any time by deducting the readings of one meter from those of the other.

TABLE II—INITIAL COST COMPARISON ON ENGINE, LOW-PRESSURE AND HIGH-PRESSURE UNITS

	Main Engine	Exhaust Turbo-Generator	High-Pressure Turbo-Generator
Engine	$18,375	$12,000	$14,000
Foundations	1,644	.....	800
Generator	10,650	.....	.....
Total	$30,669	$12,000	$14,800
Condenser	2,700	4,534	5,000
Piping	5,500	8,305	6,000
Exciter	2,175	1,450	1,750
Total	$41,044	$26,289	$27,550
	26,289		2,755
Grand total	$67,333		$30,305

Vacuum is maintained in the condenser by a 6-in. by 14-in. by 12-in. single, horizontal, straight-line rotative dry-vacuum pump with a 6-in. suction and a 4-in. atmospheric discharge.

Arrangement of Piping

As shown in the accompanying diagram (Fig. 5), the general piping provides that the exhaust of the exciter and auxiliaries can be turned either into the feed-water heaters or to the engine exhaust, and, when the turbine throttle is closed, into the atmosphere. In addition, for testing purposes, the condenser auxiliaries have an exhaust into the condenser. By closing valve *A* and opening *B* all the exhaust steam is turned through the separator into the turbine, and by reversing the operation the steam goes through the heaters into the boiler room. By opening valve *C* and closing *F* everything goes to the atmosphere. When *D* is opened the exhaust from the auxiliaries goes into the condenser.

Table II gives the costs of these units, compared with the estimated cost of a high-pressure turbo-generator of the same capacity as the combined unit. Omitting duplications, the first cost in round numbers for the combined unit is about $70,000, which is about two and one-third times the cost of a high-pressure machine of the same capacity.

In testing the engine and its low-pressure turbine a large number of runs were made through a thirty-hour period during which the water discharged from the condenser was weighed. The drains from the receiver and separator were also weighed from time to time as seemed necessary. As no resistance barrels were used, the runs at full load were confined to periods of the day when the load was constant. During the final run, which was taken as giving the correct tested water rate of the turbine, the steam pressure near the turbine was 16.77 lb. absolute, with moisture 2.46 per cent by calorimeter and a vacuum of 0.883 lb. absolute. The data in Table III give the essential results bearing upon the economy of the turbine.

The correction for moisture was taken from the records of the manufacturer. This was 2 per cent on the steam consumption per kilowatt-hour for every 1 per cent of moisture. A correction of 3 lb. for every inch of vacuum was also made. The following results are tabulated for the corrected steam consumption of the turbine:

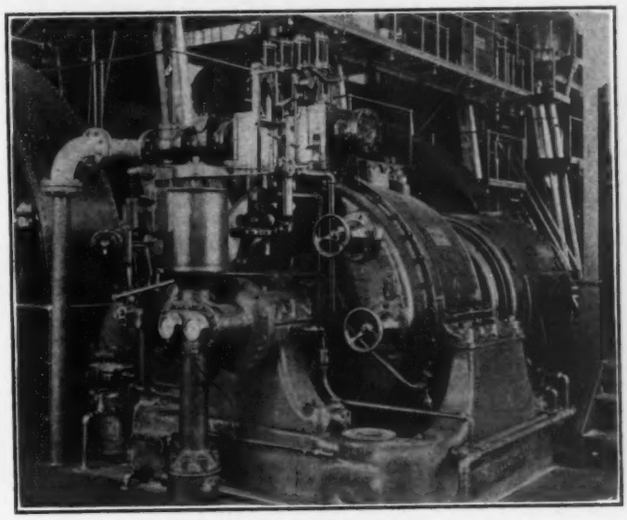


FIG. 6—LOW-PRESSURE TURBINE

Steam to the turbine as weighed, per kw-hr., lb	37.28
Steam corrected for moisture, by calorimeter, per kw-hr., lb	35.45
Steam corrected for vacuum, by calorimeter, per kw-hr., lb	36.02
Steam corrected for moisture as calculated, per kw-hr., lb	34.84
Steam corrected for vacuum as calculated, per kw-hr., lb	35.41

A number of runs were made with the turbine at varying loads, and the more important data are presented in Table IV.

The tests showed that for half load the steam consumption is within the guarantee, as well as for other loads.

A comparison between the result for the entire unit at full load and that obtained for the associated engine on a previous test indicates the saving in steam consumption resulting from the use of the low-pressure turbine. With the complete unit as now connected, the consumption per kilowatt-hour, including the auxiliaries connected with the condenser, is 17.3 lb. per kw-hr.

When formerly tested, the engine operating condensing without the auxiliaries consumed 20.5 lb. of steam per kw-hr.; with the air-pump it consumed from 22 lb. to 22.5 lb. Taking the steam consumption at 22 lb., the gain is 4.7 lb. per kw-hr. Professor Hollis states in his report that if run continuously there would be a saving of over $9,000 in the use of the unit, making no allowance for the interest on its investment or the increased cost of running. The net saving due to the introduction of the turbine was estimated by him to be about $5,000 per year.

Results from Practical Operation

In the practical operation of the low-pressure unit it has been found that the most economical results are obtained when the exhaust of the auxiliaries is discharged into the turbine. The tests showed that the moisture in the turbine should in practice be kept down as low as possible by draining the receiver and separator. Any moisture entering the turbine lessens the amount of dry steam on the one hand and increases the resistance to the turbine disks on the other.

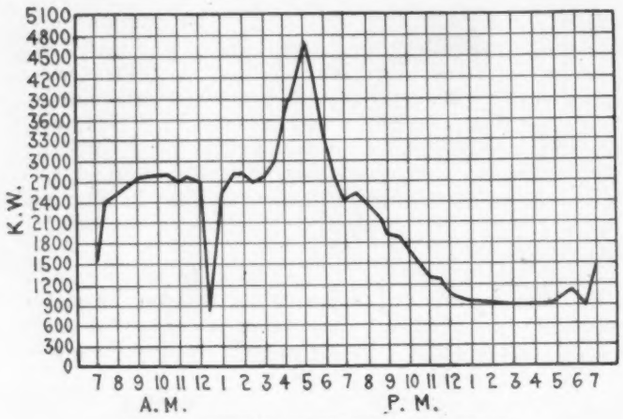


FIG. 7—TYPICAL DECEMBER LOAD CURVE

TABLE III—DATA ON TURBINE ECONOMY

Weight of water from condenser, lb. per hour	18,398
Moisture by calorimeter, per cent	2.46
Moisture by calculation, per cent	3.27
Drain from receiver, lb. per hour	173
Drain from separator, lb. per hour	408
Steam to circulating pump, lb. per hour	475
Steam to wet vacuum pump, lb. per hour	250
Steam to dry vacuum pump, lb. per hour	150
Steam to all auxiliaries, lb. per hour	875
Steam to high-pressure cylinder, lb. per hour	18,104
Steam to low-pressure cylinder, lb. per hour	17,932
Steam pressure at engine throttle, gage, lb. per sq. in	158
Steam pressure at receiver, absolute, lb. per sq. in	39.37
Steam pressure at turbine throttle, absolute, lb. per sq. in	16.77
Pressure in condenser, absolute, lb. per sq. in	0.883
Barometer, in.	29.65
Temperature of steam at engine throttle, Fahr	421.3
Superheat of steam at engine throttle, Fahr	51.6
Temperature of steam in receiver, Fahr	260.7
Temperature of steam at turbine throttle, Fahr	218.5
Temperature of injection water, Fahr	68
Temperature of discharge water, Fahr	86
Temperature of condensed steam, Fahr	90
Temperature of engine room, Fahr	95
Speed of main engine, in r.p.m.	119.2
Speed of turbine, in r.p.m.	1,795
Piston speed, in feet per minute	834.4
Bucket speed, in feet per second	425
Indicated hp, high-pressure cylinder	606
Indicated hp, low-pressure cylinder	308
Total engine indicated hp.	914
Percentage of power in high-pressure cylinder	66
Electrical load on engine-driven generator, kw	603.5
Electrical load on engine-driven generator, hp	809
Electrical load on turbine, kw	493.5
Total load on unit complete, kw	1,097
Power factor, per cent	79.56
Steam per indicated hp-hr. in engine, lb.	19.81
Steam per kw-hr. in engine, lb.	30
Steam per kw-hr. in turbine, lb.	37.28
Steam per kw-hr. in unit, excluding auxiliaries, lb.	16.85
Steam per kw-hr. in unit, including auxiliaries, lb.	17.30
Steam per kw-hr. in auxiliaries, lb.	0.80

Since the installation of this unit the station records have been carefully examined and special runs made to ascertain its value under operating conditions and to obtain data that would help in making future extensions to the station along the same lines. The first winter's log of service shows a total saving of just 10 per cent in plant coal consumption compared with the previous winter. This saving was attributed to three causes, namely, the installation of automatic stokers, the efficiency of the low-pressure turbine set and a better loading of the engines. The company's electrical engineer states that the exhaust turbine is without doubt responsible for the last two items and should have credit for about one-half the saving.

TABLE IV—RESULTS OF RUNS AT VARYING LOADS

Water from condenser, lb. per hour	10,949
Moisture by calorimeter, per cent	2.25
Moisture by calculation, per cent	2.4
Steam to high-pressure cylinder, lb. per hour	10,493
Steam to low-pressure cylinder, lb. per hour	10,320
Indicated hp, high-pressure cylinder	374
Indicated hp, low-pressure cylinder	133
Indicated hp, total	507
Percentage of power in high-pressure cylinder	74
Electrical load on engine, kw	302.5
Electrical load on engine, hp	406
Electrical load on turbine, kw	256.5
Electrical load on unit, total kw	559
Power factor, per cent	72.7
Steam on turbine as weighed, per kw-hr., lb.	42.67
Steam corrected for moisture by calorimeter, per kw-hr	40.75
Steam corrected for vacuum by calorimeter, per kw-hr	41.35
Steam corrected for moisture by calculation, per kw-hr	40.63
Steam corrected for vacuum by calculation, per kw-hr	41.23

That this is not too large a percentage is proved by a week's run without the turbine, when the coal consumption per kilowatt-hour increased 6 per cent. With the unit excited by a motor-driven set, 1200 kw at 76 per cent power-factor is the full capacity of the outfit. When excitation is provided by the independent steam set and its exhaust is turned into the turbine, 1250 kw can easily be handled.

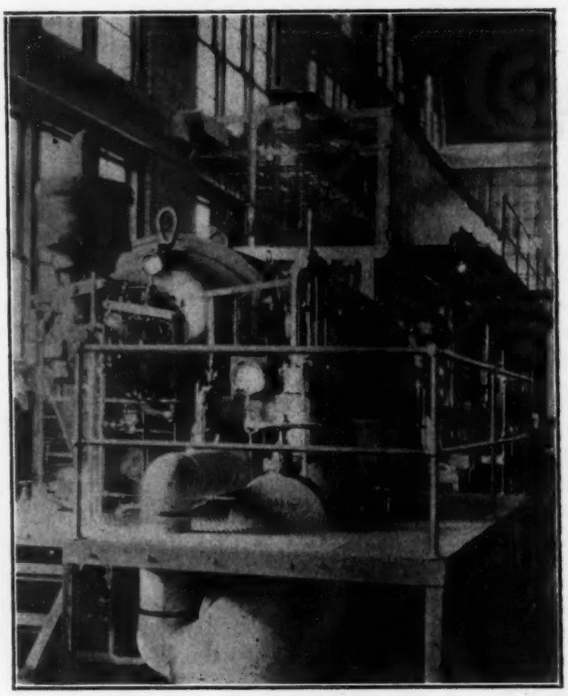


FIG. 8—1500-KW LOW-PRESSURE TURBINE

With a power-factor under 76 per cent the capacity of the turbo-generator is not over 375 kw to 400 kw.

Studying Station Conditions

The results obtained from the tests and operation of the engine and low-pressure combination indicate that the most important points in the selection of the complete outfit are a study of station conditions, in order to obtain the proper

size and type of turbine to give the highest station efficiency. Further, the cost of the outfit should be compared with the cost of a high-pressure turbo-generator of double capacity, and unless the engine units are in first-class condition, much can be said in favor of the high-pressure equipment. For the Cambridge conditions, which include engines in excellent shape, an established boiler plant which it was not considered desirable to enlarge until absolutely necessary and an engine room of restricted width, the utilization of the low-pressure turbine idea was regarded favorably from the outset and the purchase of a second unit soon followed the installation and test of the first.

The accompanying diagram shows a typical load curve of the plant for a December day and night. Table V shows the net cost of production at the station, excluding distribution, management expenses, taxes and miscellaneous costs, but including fuel, water, repairs and labor costs within the plant, for the year ended June 30, 1912. This cost represents the bare expense of manufacturing and should not be compared with the selling prices of the company.

TABLE V—MANUFACTURING COSTS

Fuel	$61,531
Oil and waste	1,454
Water	3,637
Wages at station	19,831
Station building repairs	1,866
Steam plant repairs	6,651
Electric plant repairs	5,465
Tools and appliances, approximately	768
Total (equal to 0.85 ct. per kw-hr.)	$101,203

In the above period the plant delivered at its switchboard 11,929,427 kw-hr., and the station labor account listed the services of one chief engineer, four assistant engineers, seven firemen, four coal passers, three oilers, one engine wiper and four switchboard men, or a total of twenty-four in the operating department of the plant. The cost of coal, as given above, was $4.06 per ton.

Recent improvements at the plant provide for the relocation of the operating switchboard on a gallery at one end of the engine room and the installation at that place of fifteen panels controlling all electrical circuits. At present there are seven lighting feeders of the 2300-volt, single-phase type, six 2300-volt, three-phase power feeders, one 500-volt, direct-current circuit and sixteen street-lighting circuits operated from constant-current transformers in the station basement. Oil switches in the 2300-volt circuits are placed under the switchboard gallery and two Tirrill regulators have been installed on the switchboard panels.

Two exciter buses and two 2300-volt buses are provided, the equipment being transferred from one to the other in case of emergency. Seventeen constant-current transformers are now in service, ranging in rating from fifty lamps to seventy-five lamps each.

A later article will describe the commercial practice of the company, giving data upon its operation and earnings on a total and unit basis, and will take up the electric-vehicle service and meter-testing facilities, connected load and system data.

Water Resources of the Pacific Coast

The Geological Survey has published, as Water-Supply Paper 311, its annual volume for 1911 showing the results of the measurements of the principal streams of the Pacific Coast in California. The field work has been carried on by the federal survey in co-operation with the State of California, and gaging stations were maintained during the year at about 200 points. These records of the behavior of rivers throughout the year, and year after year, are of the utmost importance in the consideration of all projects relating to the development of water supply for irrigation, power, etc.

Electrical Equipment of a North Carolina Mountain Resort

By H. Minor Friend, Jr.

In the Blue Ridge Mountains of North Carolina, in the southwestern part of the State, is Lake Toxaway, an artificial body of water formed by placing a dam across the

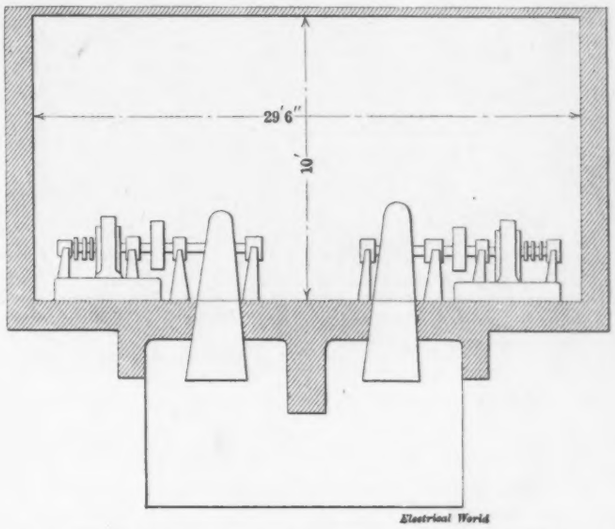


FIG. 1—SECTION THROUGH GENERATING STATION

Toxaway River. On the bank of the lake is a modern summer resort known as Toxaway Inn, and this is supplied with electricity from a small hydroelectric plant utilizing the water from the lake. The latter, which has an area of 580 acres and an average depth of 20 ft., is fed by three mountain streams besides the river after which it is named; but their flow is so small that no cofferdam was needed in building the dam. After the dam was completed, it required six months for the lake to reach its present level.

The dam is made up of a concrete core wall 500 ft. long and 72 ft. high, covered with broken stone and earth, and a wagon road has been constructed along the top of it. The spillway is constructed on a small auxiliary dam built at an angle to the main dam.

The penstock penetrates the dam near the spillway, 6 ft. below the level of the lake. At its lower end the penstock

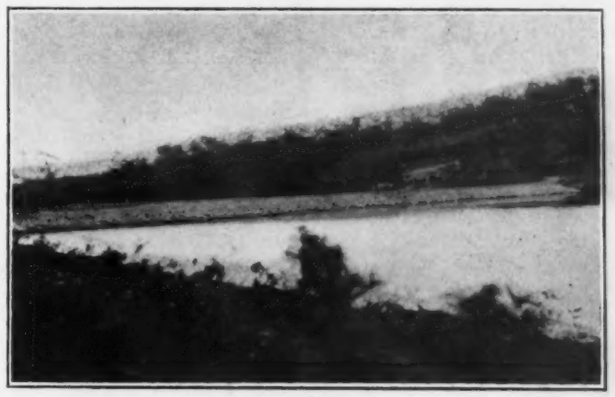


FIG. 2—MAIN DAM AT LAKE TOXAWAY

divides into two 14-in. pipes which lead through hand-operated valves to the turbines. Owing to the irregular topography of the country in this section it has been possible so to locate the small stone power house that a head of 180 ft. has been secured.

The present equipment of the station consists of two 100-kva, 2300-volt, three-phase, 60-cycle Westinghouse generators, driven by S. Morgan Smith water turbines of

the horizontal type; two pumps which supply the oil pressure for the Lombard governors, and two commutating pole exciters rated at 3 kw, 125 volts, 2620 r.p.m. Both the pumps and the exciters are driven from the shafts of the turbines through belts. Connections have been provided for operating the generators in parallel, but at present

FIG. 3—POWER STATION AND OUTGOING TRANSMISSION LINE

one machine is able to supply the load and one set is held in reserve.

The entire output of the station is delivered at 2300 volts to a three-phase line leading to the hotel. The line is constructed on 35-ft. wooden poles spaced 150 ft. apartt. The stranded copper conductors are strung on pin insulators on a single cross-arm, and at the top of the pole a stranded steel ground wire is carried. For protection against lightning a set of multi-gap lightning arresters has been installed at the station and at six equidistant points along the 1½ miles of line. The ground wire is connected to earth at each pole and at each end of the line.

The transformer equipment at the hotel consists of two delta-connected banks, the smaller rated at 25 kva each, reducing the voltage of the line to 110 volts, for lighting purposes, while the larger bank, consisting of three 30-kva transformers, supplies the 220-volt motor circuits. The transformers are of the Westinghouse oil-insulated, self-cooled type. The 110-volt circuit supplies the lamps in the 200-room hotel and in the various outbuildings, some cooking utensils in the kitchen and the electric heaters with which some of the suites are equipped. The 220-volt circuit feeds the motors of the laundry and the refrigerating plant.

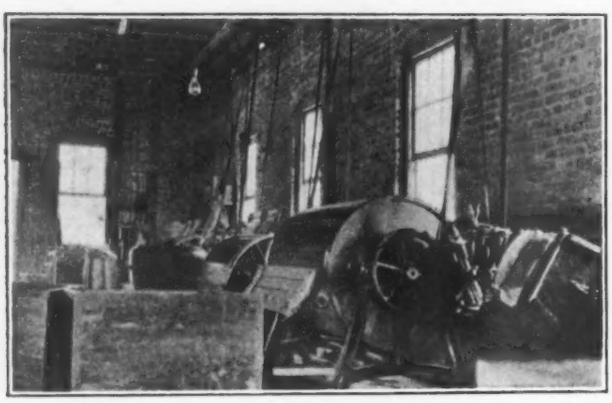


FIG. 4—MOTOR-DRIVEN LAUNDRY

A 15-hp, three-phase induction motor is mounted on the ceiling in the laundry and drives the line shaft which operates all of the machines and rolls. The smaller rolls are electrically heated, but the large ones used for flat work are heated with steam. The laundry equipment consists of two washing machines, one ringer, one tumbler, five large rolls and one set of small rolls. It is claimed that one attendant does the same amount of work with this installation as was formerly accomplished by ten.

In the refrigerating plant a 15-hp, three-phase induction motor drives a Frick ice machine which has a daily output of 1250 lb. of ice. The brine for refrigerating the several cold-storage rooms is circulated by a pump which is direct-connected to a 5-hp induction motor.

The installation was put into service last June and supplanted an antiquated steam-driven system which operated at 250 volts. In the near future the line will be extended to encircle the lake and supply electrical energy to all of the cottages along the shore.

The Reactance of Stranded Conductors

By H. B. Dwight

In the calculation of transmission-line constants it is necessary to distinguish between stranded cables and solid wires, especially as regards reactance. For example, the reactance of a No. 0000 cable of seven wires at 60 cycles and with a spacing of 18 in. is 0.552 ohm per mile. The reactance of a solid wire of the same sectional area is 0.560 ohm, or 1.5 per cent greater, while the reactance of a solid wire of the same diameter as the cable is 0.544 ohm, or 1.5 per cent less than the reactance of the cable.

It is therefore advisable to use special formulas to calculate the reactance of cables. The derivation of the formula for a seven-wire strand is indicated in the following paragraphs, and formulas are also given for strands of other numbers of wires for use in overhead transmission-line calculations.

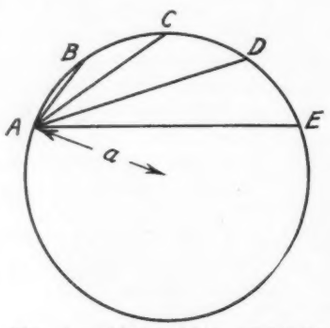


FIG. 1—GEOMETRICAL DIVISION OF THE CIRCLE

The reactive voltage drop in an alternating-current circuit is due to alternating magnetic flux surrounding the conductors. Since flux which cuts both conductors does not produce a difference in voltage between them, and therefore does not produce any reactive drop in the circuit, only that part of the flux must be considered which cuts one cable and not the other. It is necessary to calculate the voltage induced in each small wire of the cable A (Fig. 2) by the flux in the space s produced by each of the wires of cable A. The radius of the cable is considered small compared with the distance s. Round wires may be considered to be replaced by very small conductors located at the centers of the wires, as far as the inductance of one wire on another is concerned. The correction in inductance due to skin effect may be neglected, as it is very small for ordinary cables at 25 or 60 cycles.

Suppose that the current in each small wire has unit value. Then the flux density due to that current, at a distance x from the center of the wire, is $\frac{2}{x}$

If t is the distance between any two wires of the cable, the required voltage induced in the second by the first, per centimeter, is

$$2\pi f \int_t^s \frac{2}{x} dx = 2\pi f \times 2 \log_e \frac{s}{t}$$

$$= 2\pi f M$$

where f is the frequency and M is the inductance for the pair of wires.

The inductance of a wire due to its own current is given by the usual formula

$$L_1 = 2\log_e \frac{s}{r} + \frac{1}{2}$$

in which r is the radius of the wire and in which $\frac{1}{2}$ expresses the effect of the flux inside the wire.

The inductance per centimeter of cable of a single-phase circuit composed of seven-wire cables (Fig. 2) is proportional to

$$L' = 7L_1 + 12M_1 + 30M_2$$

where L_1 is the inductance of each wire due to its own current, M_1 is the inductance for pairs consisting of the

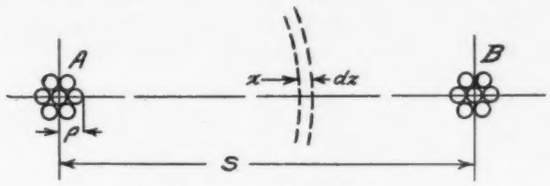


FIG. 2—STRANDED CONDUCTORS IN CIRCUIT

center wire and an outer wire, and M_2 is the average inductance for pairs consisting of two outer wires.

Then,

$$L_1 = 2\log_e \frac{s}{r} + \frac{1}{2}$$

and

$$M_1 = 2\log_e \frac{s}{2r}.$$

For the third term it is convenient to use the following theorem:

If a circle of radius a (Fig. 1) be divided into m equal parts at A, B, C, D, etc., then

AB, AC, AD, etc. (to $m-1$ factors) $= ma^{m-1}$ *

Thus the mean value of $\log t = \log\left(\frac{1}{am^{m-1}}\right)$.

The average value of M_2 is therefore

$$2\log_e \frac{s}{2r6^{\frac{1}{2}}}$$

Therefore,

$$L' = 98\log_e \frac{s}{r} + \frac{7}{2} - 24\log_e 2 - 60\log_e 2 - 12\log_e 6$$

In the above the voltages induced in the seven wires have been added together and unit current has been assumed for each wire. Considering the cable as a single conductor, its inductance will be

$$L = \frac{1}{49}L'$$

Changing to practical units and referring to the maximum radius of the cable,

$$\rho = 3r,$$

Then,

$$L = \left(103.3 + 741.13\log_{10}\frac{s}{\rho}\right)10^{-6}$$

henries per mile of conductor.

Applying the above method to a strand of n wires composed of p layers around a center wire (Fig. 3, b and c),

$$n = 1 + 6 + 6\times 2 + 6\times 3 + \ldots + 6\times p$$
$$= 3p^2 + 3p + 1$$

and

$$L = 2\log_e \frac{s}{\rho} + \frac{1}{2n} + 2\log_e (2p+1) - \frac{2(n-1)}{n^2}\log_e 3$$
$$- \frac{24}{n^2}\left\{4\log_e 2 + 2\times 13\log_e 4 + 3\times 28\log_e 6 + \ldots\right.$$
$$\left. \ldots + p(n-3p)\log_e (2p)\right\}$$

*E. B. Rosa, *Bulletin of the Bureau of Standards*, 1907, Vol. IV, No. 2. page 335.

This gives

for $n = 7$ and $p = 1$, $L = \left(103.3 + 741.13\log_{10}\frac{s}{\rho}\right)10^{-6}$,

for $n = 19$ and $p = 2$, $L = \left(89.3 + 741.13\log_{10}\frac{s}{\rho}\right)10^{-6}$,

for $n = 37$ and $p = 3$, $L = \left(85.1 + 741.13\log_{10}\frac{s}{\rho}\right)10^{-6}$,

for $n = 61$ and $p = 4$, $L = \left(83.3 + 741.13\log_{10}\frac{s}{\rho}\right)10^{-6}$,

and for solid wire,

$n = 1$ and $p = 0$, $L = \left(80.5 + 741.13\log_{10}\frac{s}{\rho}\right)10^{-6}$.

A three-wire strand (Fig. 3 a) is a special case, since there is no central wire. The inductance is

$$L = 2\log_e \frac{s}{\rho} + \frac{1}{6} + 2\log_e\left(\frac{2\sqrt{3}+3}{3}\right) - \frac{4}{3}\log_e 2 \text{ per cm.}$$

Therefore $L = \left(125.2 + 741.13\log_{10}\frac{s}{\rho}\right)10^{-6}$ henries per mile, where ρ is the radius of the circumscribing circle of the cable.

The above equations may be put in the following simplified form, which is more convenient for calculating:

No. of Wires in Strand.	Inductance per Mile in Henries.
3	$L = 741.13\log_{10}\frac{2.951\,s}{d}\times 10^{-6}$
7	$L = 741.13\log_{10}\frac{2.756\,s}{d}\times 10^{-6}$
19	$L = 741.13\log_{10}\frac{2.640\,s}{d}\times 10^{-6}$
37	$L = 741.13\log_{10}\frac{2.605\,s}{d}\times 10^{-6}$
61	$L = 741.13\log_{10}\frac{2.590\,s}{a}\times 10^{-6}$
1 (single wire)	$L = 741.13\log_{10}\frac{2.568\,s}{a}\times 10^{-6}$

where d is the outside diameter of the cable, measured in the same units as s, the spacing between cable centers.

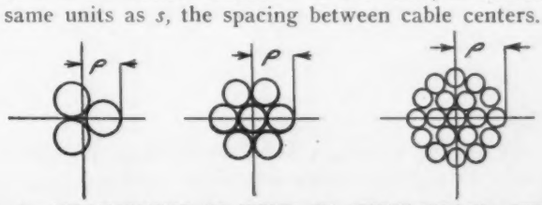


FIG. 3—ARRANGEMENT OF WIRES IN THREE-STRAND, SEVEN-STRAND AND NINETEEN-STRAND CABLE

The significance of the above equations is best appreciated by consideration of the following examples of calculated reactance. The values tabulated are in ohms per mile at 60 cycles, where

Reactance in ohms $= 2\pi \times 60\,L$.

REACTANCE PER MILE AT 60 CYCLES OF NO. 4-0 WIRE AND CABLE, 211,600 CIRC. MIL

Feet Spacing	Solid Wire	3-Wire Strand	7-Wire Strand	19-Wire Strand	37-Wire Strand	61-Wire Strand
1.5	0.560	0.550	0.552	0.546	0.544	0.543
6.0	0.728	0.718	0.521	0.714	0.712	0.711
12.0	0.812	0.802	0.805	0.799	0.797	0.796

The reactance of the cables is less than that of the wire because the diameter is larger, though the sectional area is the same.

Central Station Management

Devoted to Discussion of Administrative Policies, Commercial Methods, and Current Practice Among Successful Utilities

Exhibition Room in St. Louis

The Union Electric Light & Power Company, of St. Louis, is contemplating elaborate changes in its exhibition and demonstration rooms for electric appliances. Mr. C. E. Michel, formerly manager of the automobile department of this company and now manager of the electric-appliance department, will have charge of the work. He has planned to install wall-cases lined with black velvet and lighted from the interior by special showcase lamps. Access to the cases will be had by sliding the front glass toward the ceiling. Individual showcases for single articles will be another feature of the change. These cases will have the Union Electric trademark worked in the glass.

The room adjoining the exhibition room is to be used for demonstrating economical electric household necessities and other electric appliances, such as glue-pot heaters and small refrigerating machines. These changes are being introduced in order that the salesmen may interest their prospective customers in electrical appliances. About $4,000 is to be expended on the improvements.

Combination Ice-Electric Plant Minimizes Operating Expense

A local company in a Southwestern town of 2500 population bought a combination ice-electric plant as a going business. The maximum output of which the plant was capable was 20 tons daily and there was storage capacity for 250 tons of ice. It is estimated that the portion of the investment chargeable to the ice plant is approximately $20,000. The data in the accompanying table show that even a "second-hand" ice plant can be a money-maker:

Gross annual income	$10,243.49
Total yearly expense	8,528.32
Net income from ice business	$1,715.17

That the manager of this concern is well satisfied with the 8.5 per cent net profit which the plant is showing is evidenced by the statement he makes concerning the ice business in general. In substance he says: "In towns of 7000 inhabitants or less combining the lighting and ice business under one head provides a harmonizing industry over the entire twelve months of the year. It presents an excellent opportunity to concentrate working forces and minimize the operating expenses of both branches of the work."

Electric Service and the Safety of the Child

The child of well-to-do parents in a prosperous suburban town was seriously burned and considerable damage was done to the house the other day, when the youngster got hold of some matches carelessly left lying about. While the usually vigilant mother was busy in another room he started a fire with the contents of a waste-paper basket, which practically destroyed the nursery, endangering the lives of the family.

Soon after the accident the central-station solicitor urged that, inasmuch as the upper story would have to be rebuilt anyhow, the time was now opportune to have the entire house so wired that it would become indeed a "matchless" home. Anything that would be likely to prevent a recurrence of the recent mishap made, of course, a forcible appeal to the parents. Electricity was accordingly installed from garret to cellar, and no more matches are allowed in that home under any circumstances.

This gave the solicitor an excellent talking point with other parents, and as a result a number of houses installed complete electric outfits. The philoprogenitive instinct is so dominant in the average parent that he can often be reached through being shown the safety to the children where electricity is used, as well as the comfort of the household in general. This avenue of appeal is one often overlooked by the solicitor.

What Can the Motor-Service Salesman Earn?

The value of a given motor-service contract to the central station is very much like the value of a policy to a life-insurance company, and the amount the central station could afford to pay to get the contract can be figured upon similar lines. Unfortunately, however, the idea generally prevalent seems to be that a utilities company will make the most money by paying as little as possible to get contracts. It is, nevertheless, easily possible to increase energy sales 50 per cent at a trebled selling cost and still make more profit on the whole transaction. Until central-station salesmen and sales managers are paid in proportion to the business done, companies will not get the maximum possible profitable business.

This policy of paying salesmen adequately has been so fully demonstrated in other analogous lines that proof is hardly necessary. The most troublesome point is arranging a proper scale. Some striking contrasts could be drawn between various cities, among which the remuneration paid in the company sales departments is as different as the increase in connected motor load. Under the generally prevalent straight-salary system the higher salaries are not paid because the department is getting good business, but, rather, it is getting that business because the corporation was wise enough to offer such salaries as would attract the class of men capable of getting results.

Utilities corporations look far ahead in providing fuel supplies and in making franchise arrangements. If they will similarly carefully analyze the future value of a motor-load contract and capitalize this value, they will find they can afford to pay much more to secure the contract than is generally done at present. In other words, even paying a considerable amount to a productive and efficient sales department there will still be a very handsome selling profit for the company over and above the reasonable operating profit which should be considered part of the gross cost of producing the energy.

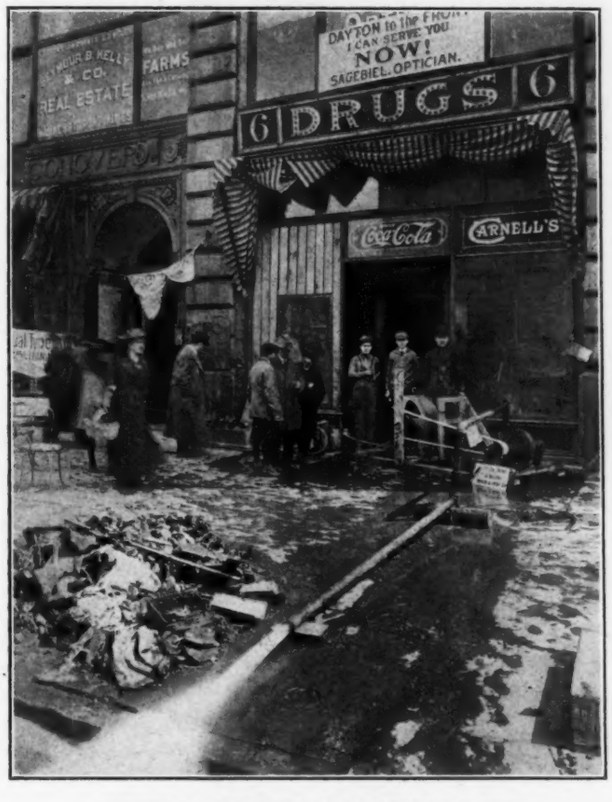
It is suprising that some public-service companies still take the attitude that they will eventually get all the motor-load business anyhow, and that it is up to the consumer to come to them and take it at their terms. Of course, such companies usually maintain a feeble sales force, but successful selling is made difficult by that position, which precludes sufficient flexibility in rates or contract forms really to help get the good business, and likewise precludes pay-

ing enough to get good salesmen. In one large city, for example, there are at least twenty salesmen of engines, boilers, pumps, and even feed-water heaters, earning more money than the manager of the central-station sales department. In fact, anyone who wishes to learn the comparative progressiveness of central stations in various cities can get reliable information from the sales records of the high-speed engine builders. Their sales show pretty clearly where canvassing for the disposal of electrical energy in industrial service has been efficiently carried on and where, on the other hand, it has been neglected.

Central-Station Pumping of Flooded Basements at Dayton

Second in importance to restoring light to Dayton, Ohio, after the disaster that visited that city, was the service rendered by the local central-station company in pumping from basements in the business section the water left by the receding flood. As soon as the streets were cleared centrifugal pumps and motors were collected from all available sources and put to work freeing the basements of the stagnated waters. Taps were taken from the nearest service wires to operate the motors and temporary pipe connections were rigged up as shown, discharging into the gutters. Motors and pumps were mounted on rough skids and the controlling arrangements were pretty crude, but the pumps worked and rapidly freed the flooded cellarways of water.

Alert to the opportunity afforded for advertising central-station service despite the distractions of the moment, Mr. T. F. Kelly, sales manager of the Dayton company, had a number of placards printed with the words, "Electric Pump, the Dayton Power & Light Company," as shown in the illustration, and one or more of these cards were affixed to each emergency-pumping installation as soon as it got into operation.



MOTOR-DRIVEN PUMP AT WORK IN DAYTON

Emergency Service Connections at Dayton

As the flood receded from the streets of the business section of Dayton most of the basements were left filled with water, rendering useless the regular underground-cable service connections with the Dayton central-station company's distribution system. As rapidly as possible, however, the company's manholes were freed of water and lines were run up through the open covers to temporary connections through the second-story windows of adjacent office buildings. The accompanying illustration shows an emergency service run of this kind, supported by dead-ending to a trolley pole. The building at the left receiving this rough-and-ready service is the Rike-Kumler store. A protecting barrier was built about the wires and open manhole, and a member of the military was left to guard the public against possible accident. In other instances the wires from the manholes were carried aloft on temporary poles set into barrels filled with rocks and bricks. In this way hurried connections were made with such clear circuits as remained in service, restoring light to the stricken city at the earliest possible moment. This emergency service also proved of great usefulness in operating the pumps with which basements were freed of water.

TEMPORARY CONNECTIONS FROM MANHOLE TO CONSUMER, DAYTON

Helping the Competitor

A startling example of the inability of the ordinary artificial-ice plant to cope with the combination station in which by-product ice is made is shown by the following statement: "During the off-peak period, which lasts in the ice business throughout the winter months, we have been selling ice to several local refrigerating plants in this district. One of these concerns is our most active competitor in this city, yet the rate at which we are able to supply it with the frozen product justifies it in shutting down its plant through the winter months and as far into the spring as we are able to continue to furnish ice to it." The combination ice-electric company from which this statement was obtained has recently erected a new absorption ice

plant. That it is obtaining enviable results along the line of economic production is clearly shown by the foregoing.

By shipping ice in its own ice cars, which are operated over the electric interurban lines in the surrounding territory, a wide market is opened to this company. In this manner the ice plant is maintained in operation at nearly rated output throughout the entire year.

Securng Full-Schedule Business from "Break-Down" Prospects

Frequently the isolated-plant owner who applies to the central station for "break-down" or emergency connection can be convinced of the advantage and economy of purchasing his entire energy requirements outright from the central station, if careful study is made of his conditions and proper arguments advanced by the company's sales representative. The list of customers who already have contracts for break-down service will also prove a fertile field for full-schedule contracts if the solicitor is prepared to prove to the break-down customer that money can be saved for him if he will abolish his unreliable isolated equipment and depend on central-station service exclusively.

In computing the total cost of break-down auxiliary service the factors to be considered are: Break-down service charge on installation per month, killowatts-hours consumed per month, and isolated-plant generating cost per month. The actual cost (C) per kilowatt-hour to the consumer for the combined sources of supply is given by the formula:

$$C=G+\frac{B}{K}$$

where G is the isolated-plant generating cost per kilowatt-hour at service wires, B is the monthly break-down service charge on the installation, and K is the kilowatt-hour consumption per month.

Inspection of the formula will show that as long as the total cost of the customer's service C is higher than the regular service rate charged by the central station, the customer will save money by shutting down his plant and trading his break-down contract for complete regular service. If the value represented by the formula is less than this standard service charge, the customer is justified in considering break-down service only, and the solicitor can save his efforts for some more promising prospective customer.

Following is an example of the use of this formula in a case where the customer finally followed the central-station representative's advice and completely shut down his plant. In this instance the "prospect" had sent in an application for a break-down service connection, but when the sales representative arrived the customer explained that he had changed his mind in favor of a gas installation.

Using diplomacy, the solicitor set out first of all to get acquainted with his "prospect," although he did not press the object of his visit or indeed mention it after hearing the customer's expressed preference in favor of industrial gas. He succeeded in getting permission, however, to examine the premises, and the first visit closed pleasantly with the treat of a good cigar for the customer.

The central-station rate for regular service was 10 cents per kw-hr., while the isolated-plant cost, G, was 3 cents per kw-hr. Break-down service connection was costing at the rate of 10 cents per month for each 50-watt equivalent. Hence, for the 10-kw load B had a value of 2000. Transposing the formula, and substituting:

$$K=\frac{B}{C-G}=\frac{2000}{(10-3)}=285$$

This put the representative on his guard to see that in making any calculations with the customer he used values for the total consumption well within 285 kw-hr. per month, or else his arguments would be pointless. Since the monthly average consumption agreed upon was 200 kw-hr., the customer was shown that his combined service was costing him

$$C=\left[G+\frac{B}{K}\right]=\left[.3+\frac{2000}{200}\right]=13 \text{ cents.}$$

As the central-station proposed to furnish all required energy for 10 cents per kw-hr., permitting the shutting down of the private plant, the economy of taking central-station service exclusively was proved and the contract was closed on the regular schedule basis. It might be added that the company had been after this business for eight years, but until the problem received this simple analysis the central station had never been able to secure the contract.

Spectacular Electric Sign at Springfield, Ill.

The accompanying illustration shows a large and very effective spectacular electrical display recently installed at Springfield, Ill., by Messrs. Ogg & Snell, cigar manufacturers. The sign, which is 26 ft. high, 20 ft. wide and contains 750 five-watt lamps, was built by the Greenwood Advertising Company, Knoxville, Tenn. Its cost, including color caps, flasher and back bracing, but without lamps, was $850.

When in operation the display shows the clown reaching

ELECTRIC SIGN AT SPRINGFIELD, ILL.

into his pocket five times in succession, each time tossing a ball toward one of the display lines. As the ball reaches its destination it explodes with a burst of light, and the line lights up. All of the words than remain illuminated until the story is told, when the whole display is extinguished and the operation is repeated. The period of action is thirty seconds, the entire electrical effect being controlled by a Betts & Betts flasher driven by a 0.33-hp motor.

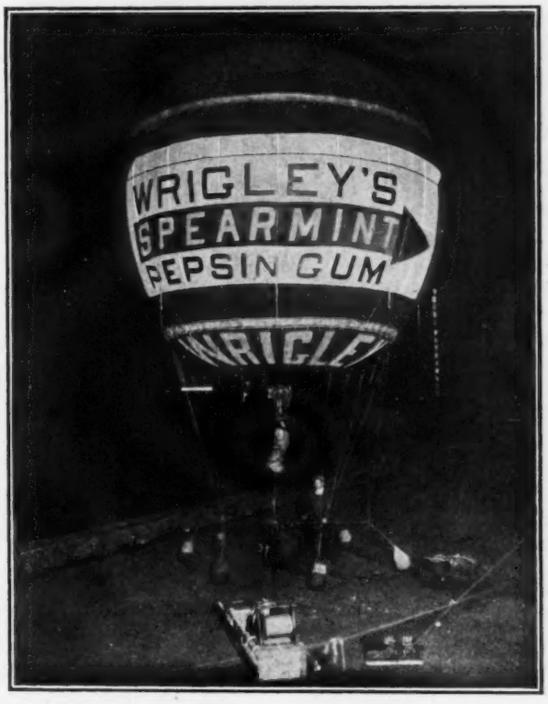
The sign above described is one of 200 local displays now supplied with electrical energy by the Springfield Light, Heat & Power Company, which, with the co-operation of sign manufacturers, has recently had under way a very successful electric-sign campaign. The plan has been to pair off members of the sign manufacturer's sales staff with the central-station company's new-business men and let them interview prospective customers together.

In one such campaign of four days' duration contracts were obtained for twelve electric signs averaging 140 five-watt lamps each. The largest sign for which a contract was closed during this time contained 246 five-watt lamps. Mr. C. L. Owen, superintendent of the Springfield company's new-business department, jointly with the sign manufacturer's representative, holds a record, he having obtained eight contracts in one day.

Illumination and Wiring

An Electrically Lighted Balloon

Habitués of the "Great White Way" district of New York City during the last few months have had their attention distracted from the bright lights nearer at hand to the unusual spectacle of an electrically lighted balloon sailing serenely over Broadway near Thirty-seventh Street. The captive gas-bag is used for advertising purposes and is lighted from within by a 500-watt tungsten lamp inclosed in the impervious envelope which affords an excellent diffusing surface. By means of an anchor cable and reel the balloon can be raised and lowered. Ordinarily cable is paid out to a height of 500 ft., at which elevation the 20-ft. illuminated sphere with its advertising legend is a prominent feature against the night sky of Manhattan. Energy to light the unique display is furnished by the New York Edison Company, doubtless the first application of central-station service to so unusual a purpose. The photograph



ELECTRICALLY LIGHTED BALLOON USED FOR ADVERTISING

shows the balloon weighted with sand-bags preparatory to making the ascent. A separate pair of conductors is provided for the lamp, it will be noticed, all mechanical strains of anchoring being met by the special cable on the hand reel shown.

Who Was to Blame?

A layman sends to the *Electrical World* the following little tale which he thinks points the moral that in the large city where he lives there is room for improvement either in the methods of the central station or in those of the working electricians, or perhaps in both.

Having just moved into a two-story apartment where the previous tenant used electricity and desiring to do likewise, he notified the central-station company, which after the usual preliminaries sent up two men, who installed the meter and connected to the service mains. It was then found that only the lamps in the rear of the first floor would operate, the others on that floor and all on the second floor remaining dark. After some fruitless experimenting the men left, saying that there was a short-circuit somewhere which the landlord should remove. On being appealed to, the landlord promptly sent an electrician, who repeated the central-station men's experiments with equal lack of success, and departed—to return in a day or two with another man. The two then spent half a day in testing and hunting, the only results being a long-continued and general daylight illumination from all the lamps that would burn—perhaps intended to prove that the meter at any rate was working—and a very much disorganized condition of the various fixtures. The men talked ominously of a short-circuit in the walls, but before attacking these said they would return with a "magneto."

After a week's rest and study they came again, bringing this time a third man, who the innocent tenant thought might be the magneto of whom they spoke. If so, he was a qualified one, for before a great while he was heard to shout from the second-story hall: "I've got it, Jim! There's a cut-out on this floor." Sure enough, in a rather dark passageway there was recessed into the wall a mysterious apparatus which it is but fair to say paperhangers had done their best to conceal. The wall-paper had, however, broken away over the cavity, and the family were aware of the affair, the existence of which they would certainly have called to the men's attention had they supposed for one instant that the electrical experts were ignorant of it. After this discovery it was the work of only five minutes to get all the lamps in circuit.

The chief sufferer was the landlord, who received a bill for $20 from the electricians. What is worrying the tenant—whose altruism embraces even his landlord and who, besides, has disturbing visions of increased rent and deferred repairs—is why, assuming that no one showed stupidity, there should not have been affixed to the meter shelf a plate or card explaining the wiring scheme of the house.

New Lamps on Dearborn Street, Chicago

New special street-lighting lamps on Dearborn Street, Chicago, were lighted for the first time on April 5, illuminating both sides of the street in the Loop district for ten blocks. The light from these 107 flaming-arc lamps presented quite a contrast to that given by the twenty-two arc lamps previously provided by the city for lighting the same district. The new long-life alternating-current series flaming lamps are the recent production of the General Electric Company and have been suspended from ornamental brackets secured to extensions set in the tops of the existing tubular street poles supporting the trolley span wires. The illustration (Fig. 1) shows a street-railway pole in front of the Federal Building equipped with one of the new lamps. This

INSTALLATION AND OPERATING COSTS OF PROPOSED LIGHTING SYSTEMS.

Proposed Systems	Installation	Maintenance and Operating Cost per Year
Four 250-watt tungstens per post, ornamental bracket; 396 lamps in globes	$25,467	$11,446
General Electric ornamental 500-watt direct-current arc lamps; 198 lamps, two lamps per post	31,120	9,693
General Electric 500-watt alternating-current, flaming-arc lamps; 198 lamps, two lamps per post	30,724	6,060
Stave 425-watt flaming-arc lamps; 198 lamps, two lamps per post	29,520	5,005
System Adopted.—General Electric 500-watt flaming-arc; 107 lamps, one lamp per post	16,150	2,500

system of supporting the lamps was selected, as it was thought best to avoid the use of additional posts. The arc lamps chosen conform very nearly with the new units which the city has adopted. The poles are approximately 100 ft. apart and are placed opposite each other. Arranged

in this manner, the lamps are about 25 ft. above the street surface and 12 ft. from the face of the buildings, thus illuminating the buildings without interfering with window-display lighting.

Heavily insulated No. 6 cable furnished by the Standard Underground Cable Company has been used throughout the system. No spliced joints were made in the circuits, so that there are continuous cables between lamps. All cables enter through the bottom of the poles and are securely fastened beneath the sidewalks between poles.

Improved lighting for Dearborn Street has been under the consideration of the Dearborn Street Improvement Association for a year and until recently has been in the trial stage. Mr. Herbert A. Seward acted as consulting engineer for the association. Valuable assistance was received from the Chicago Association of Commerce's committee on downtown streets. The lamps were installed by the Sanitary District of Chicago, which will also furnish electricity for lighting them.

After the Dearborn Street Improvement Association had assessed property owners and tenants on the street according to their frontage, the co-operation of the city

FIGS. 1 AND 2—FLAME-ARC LIGHTING ADOPTED, AND TRIAL INSTALLATION OF INVERTED MAGNETIC UNITS

was solicited. Mr. Ray Palmer, city electrician; Mr. E. B. Ellicott, electrical engineer of the Sanitary District, and Mr. L. A. Dumond, engineer for the committee on downtown streets of the Chicago Association of Commerce, were asked to be present at a meeting and several systems of illumination were considered. Among the methods discussed were tungsten boulevard lamps, four-armed brackets supported on street-railway poles with tungsten lamps, and ornamental arc-lamp posts (Fig. 2). Two-armed brackets bearing arc lamps and supported on the street-railway poles constituted a fourth proposed system.

The first scheme considered was dropped on account of the numerous posts already on the street. It was found impracticable to use the four-armed bracket with tungsten lamps on street-railway poles on account of insufficiency of light and breakage due to vibration. The third system, tried but not adopted, showed a consumption of only 15 in. of carbon for 176 hours of service, while the General Electric Company guaranteed only 100 hours per carbon. System No. 4 was similar to No. 3 except that Stave flaming-arc lamps were figured on instead of General Electric.

An idea of the installation and operating costs of each of these systems, as stated by Mr. H. A. Seward, may be of interest and is given in the accompanying table.

A contract with the city of Chicago makes the system, when completed, the property of the city. Under the agreement the city furnished the 107 lamps installed and will operate and maintain them. The expense of operating and maintaining seventy-eight of these lamps will, however, be charged to the association at cost and will amount to about $32 per lamp per year. On this basis the association obtained a finely lighted street for about $2,500 a year.

Other propositions are now before the improvement association. The first one is that of having all of the large buildings light up the sky line of their structures. The second is to place circular flower boxes on the poles and window sills. Removal of projecting signs is also favored.

Recent Telephone Patents

Exchange Systems

The dimensions of manual multiple switchboards are limited by two factors. One is the limit of reach of the operator and the other is the minimum practicable spacing of jacks. At one time, in an endeavor to concentrate a maximum number of lines in one central office, multiple switchboards were made in several divisions, each with its own particular proportion of the multiple. Each line had an answering terminal on the division and the subscriber had to determine in advance what signal to throw and manipulate his set accordingly. Mr. E. E. Clement, of Washington, D. C., who has applied automatic apparatus to such a system, has had granted to him a patent which he has assigned to the North Electric Company. According to this system the subscriber's set is equipped with a sender and the line is terminated at the switchboard in a single answering terminal. The subscriber sets the sender and lifts his receiver. This lights a calling lamp, to which the operator responds by connecting an idle trunk. The sender is then released through automatic switching devices in the trunk and a calling signal is displayed upon the desired switchboard division. Here the call is then responded to and completed.

An improvement in automatic systems is described in a patent granted to Mr. E. Neuhold, of Germany. This system dispenses with any grounds at the subscriber's station and all operation is effected by varying the current in the line in response to the sending apparatus. Thus the impulses are caused by the momentary short-circuit of a resistor. The complete opening of the line circuit causes disconnection. The operation is brought about through the agency of two relays in series. One follows the current impulses while the other remains in the operating position even though the current is pulsating.

Mr. F. R. McBerty has obtained a patent, assigned to the Western Electric Company, which covers a "busy" test system for switchboards serving party lines. In this system each station has its own jack or terminal assigned to it, so that for four parties there are four terminals. The sleeve or test terminals are connected in pairs according to the connection of the stations to the sides of the line. The use of any terminal not only caused the establishment of a reduced potential upon this terminal and its mate, but through the agency of an auxiliary relay similar conditions are caused upon the other two terminals.

The patent granted to Mr. E. R. Hobbs, of Buhl, Idaho, also describes a "busy" test system. In this case a magneto switchboard is used and the novelty lies in arranging the drop so that a "busy" test is established as soon as a drop falls. The test is arranged upon a special test ring of the jack and is maintained by the plug in the jack after the drop is restored.

Letters to the Editors

Factors Involved in the Use of the Flicker Photometer

To the Editors of the Electrical World:

SIRS:—In the issue of the *Electrical World* for March 22, 1913, an editorial on the writer's paper on "The Purkinje Effect and Comparison of Flicker and Equality-of-Brightness Photometers" brings out some points worthy of further discussion. As all this work, including Dr. Herbert E. Ives' extensive researches, was done at the physical laboratory of the National Electric Lamp Association, the writer is familiar with all the conditions and has access to the data which are necessary for a comparative discussion. As noted in the paper, the reversed Purkinje effect found with the flicker photometer accords with Dr. Ives' results which have been published in the *Philosophical Magazine* during 1912. A study of this phenomenon was the original object of the writer's investigation; therefore red and blue-green lights were used.

As the data from which Dr. Ives concludes there is a reversed Purkinje effect with the flicker photometer were not all obtained on the same day and as he is the only one who had previously noted this phenomenon, it seemed worth while to investigate it by an independent method and to obtain a whole series of observations throughout the large range of illuminations on the same day. Moreover, it seemed desirable to test this point with a flicker photometer differing in design from his. Series of observations on various days were consistent with each other.

Why this reversed Purkinje effect should obtain with the flicker photometer is as yet unknown, but the idea that color differences should likewise make themselves felt in studies of Talbot's law such as those carried out by Dr. Hyde is not necessarily true. In using the sector disk high speeds are used regardless of the illumination.

In using the flicker photometer there is only one speed at each illumination at which the instrument is the most sensitive. This speed is always the minimum speed at which flicker can be made to disappear, and it decreases with the illumination, becoming quite slow at very low illuminations. This is in accord with the fact that at high illumination the eye is more sensitive to flicker. When the speed is slow, as at low illuminations, the time relations of color stimuli might possibly introduce variations in apparent intensity of considerable magnitude. This, however, will bear investigation.

In the *Electrical World* for Jan. 27, 1912, Dr. Louis Bell discussed the effect of simultaneous contrast in heterochromatic photometry. It is well known that a green field viewed simultaneously in juxtaposition to a red field appears greener than when viewed alone. Likewise the red field appears redder. The conditions obtaining in a photometric field are favorable to the production of the contrast effect. Dr. Bell suggests the possibility of a shift in luminosity with the shift in hue and illustrates this by means of the luminosity curve of the eye. This, if true, would explain the lower ratio of the brightness of the red lamp to that of the green lamp obtained by the equality-of-brightness photometer. But this actual shift in luminosity with the shift in hue is not yet completely established, although Dr. Bell's experiments suggest its reality. The writer has this point under consideration at the present time.

The editorial mentioned above suggested that the writer's results regarding the lower brightness ratio of the red lamp to the green lamp obtained by the equality-of-brightness method is in contradiction to the results obtained by Dr. Ives, as indicated in this statement: "Our readers will remember that in some recent researches by Dr. Ives it appeared that while at considerable intensities fairly concordant readings could be obtained by the flicker and by the equality-of-brightness photometers, yet at low values of the luminosity discrepancies appeared, sometimes showing the Purkinje effect, and in the case of the flicker instrument sometimes a small reversed Purkinje effect." This statement is not thoroughly in agreement with Dr. Ives' conclusions on pages 177 and 178 of his papers already cited. This is especially shown by comparing the foregoing statement with Dr. Ives' conclusion number six which is as follows: "The curves [spectral luminosity] are most different at low illuminations with large fields; nearest together at high illuminations and with small fields. They may under certain conditions coincide, and the mean curves of several observers show close agreement in position of maxima and shape of the two curves at high illuminations *although the areas are not the same.*" The italicized phrase, together with data on page 847 and the accompanying discussion, indicates that different relative values for lights of different colors are to be expected from the use of the two methods.

Dr. Ives' method of plotting his data as spectral luminosity curves has many advantages in a general study of heterochromatic photometry. However, when investigating the Purkinje effect or the special case of photometry of lights of widely different color such as comparing red and green lamps with each other or with a standard white source the great differences in the two methods as found by the writer are not liable to be suspected unless his luminosity curves are carefully scrutinized.

The writer in comparing a bluish-green light with a red light found a great difference in the ratios of the intensity of the red light to that of the bluish-green light by the two photometers. Luminosity curves obtained by the two methods might appear to coincide fairly, but if the ratio of the luminosity of a certain monochromatic red light to that of a monochromatic blue-green light (say at 0.640μ and 0.520μ respectively) be taken for the two methods a large difference between the two ratios might readily appear. This is illustrated by computations from Dr. Ives' data.

Computations from his data which are given in the *Philosophical Magazine*, 1912, on page 183, reveal agreement as far as conclusions can be drawn from two investigations conducted under different conditions. Dr. Ives compared pure spectral colors with a white standard. Under these conditions it is likely that there is less shifting in hue than in the case of the writer's method, where a green field was viewed in juxtaposition to a red field. The red light used by the writer was quite monochromatic with a maximum of transmission when used with a tungsten lamp at normal efficiency 0.640μ. The bluish-green glass was less monochromatic, having a maximum of transmission for tungsten light near 0.515μ. For the purpose of comparison Dr. Ives' data for his own eye at wave-lengths 0.643μ and 0.511μ, as given in Table I of his paper, are computed for both the flicker and equality-of-brightness methods at the three field sizes used by him. It will be noted that the field sizes used by the writer were about 10 deg. The larger field used by Dr. Ives more nearly corresponds to that used by the writer.

From the table it will be seen that columns three and four show a pronounced reversed Purkinje effect with the flicker photometer, at low illuminations, under certain conditions, while the regular Purkinje effect is present in the equality-of-brightness method. That there are large differences between the ratios of the red to the green luminosities by the two methods is also shown in the third and fourth columns. The last two columns show these ratios in terms of that by the flicker method, which is taken as 100 per cent in all cases. It is evident that the results vary with the field size. As the writer used field sizes of 10 deg., the largest field used by Dr. Ives is more comparable. The data shown at the bottom of the table are the mean values from the results obtained by five observers. The same general characteristics are shown here with the medium field, although

only two values of illumination were used. These data appear on pages 186 and 187 of Dr. Ives' paper.

While the data shown in the table were obtained under different photometric conditions, it is significant to note that the results obtained by the writer are in accord with them. For a long range of illumination the ratio obtained by the writer for the intensity of the red light to that of the bluish-green light was by the equality-of-brightness method only 62 per cent of that obtained by the flicker method. In some cases this is a somewhat greater difference than indicated by Dr. Ives' data at the same illuminations, but it must be remembered that in the writer's work the red and green fields were viewed in juxtaposition while in Dr. Ives' investigation they were separately compared with a white standard.

It is further shown in the writer's work that the two observers obtained different results with the flicker photometer. Owing to the fact that Dr. Ives finally recommends the use of the flicker photometer, it might be assumed by those not thoroughly acquainted with the work that concordant results are obtained with this photometer by observers with normal color vision. In Dr. Ives' last paper, on page 859, data obtained by eighteen observers are presented. On making the same computations as in the foregoing table great differences will be found even with the flicker method. For instance, observers 10 and 14, two men in the same laboratory in which all this work was done, found ratios of the brightness of the monochromatic red

COMPUTATION OF DR. IVES' DATA

	Illumination (Arbitrary Units)	Approximate Illumination (Meter Candles)	RATIO OF LUMINOSITY AT 0.643μ TO THAT AT 0.517μ		SAME REDUCED IN TERMS OF FLICKER VALUE	
			Flicker	Equality-of-Brightness	Flicker, per Cent	Equality-of-Brightness, per Cent
Large field— 8.6 deg. by 5.16 deg.	270.0	27.0	0.784	0.596	100	76.0
	68.0	6.8	0.913	0.815	100	89.3
	8.9	0.9	1.357	0.634	100	46.7
	2.85	0.3	1.115	0.452	100	40.5
Medium field— 4.58 deg. (circular)	270.0	27.0	0.818	0.774	100	94.6
	68.0	6.8	0.817	0.832	100	101.8
	8.9	0.9	1.145	0.747	100	65.2
	2.85	0.3	1.300	0.654	100	50.3
Small field— 1.86 deg. (circular)	270.0	27.0	0.782	0.827	100	105.7
	68.0	6.8	0.966	1.075	100	111.3
	8.9	0.9	1.198	1.092	100	91.2
	2.85	0.3	1.279	1.016	100	79.5
Medium field— 4.58 deg. (circular)*	250.0	25.0	1.120	1.002	100	89.5
	10.0	1.0	1.380	0.831	100	60.2

*Mean from five observers.

light to that of the monochromatic blue-green light which differed by 100 per cent, that of one being double that of the other. It is evident that these two observers would obtain widely different results when photometering lights differing greatly in color, such as red and green lamps, though they might obtain fairly concordant results with lamps differing in color only as much as do the "4-watt" carbon and the tungsten lamp. Dr. Ives realized this, as indicated by his recommendation of a method for correcting the observers' results, on page 862.

The facts brought out by the writer so far are found to verify Dr. Ives' results. However, the object of the investigation being somewhat different from that of his more general research, the writer's data give emphasis to certain points which were not so conspicuously emphasized in Dr. Ives' papers.

It might seem to some that Dr. Ives' data plotted on page 746 indicate that the results with the equality-of-brightness method published in the writer's paper might be accidental. Dr. Ives found on comparing by the same method the various spectral colors against a green standard that the positions of the spectral luminosity curves thus obtained varied considerably. He describes the results as follows: "One of the most significant things about these curves is that no system or regularity has been found in their manner of deviating from the 'normal.'" However, the writer's data indicate fairly consistent results obtained throughout several weeks. In fact, computations from five series of observations by the two photometric methods made by the writer during an interval of seven weeks showed a greater fluctation in the results by the equality-of-brightness method, while there was always a decided difference between the results by the two methods and always in the same direction. This point is under further consideration at the present time.

In closing, the writer does not wish to be understood as opposed to the use of the flicker photometer. Dr. Ives recommends its use not because it is free from perplexities but because in general it has stood the tests to better advantage than has the equality-of-brightness photometer. However, as emphasized by the writer's work, it must be used with caution and with a comprehensive realization of its shortcomings. If Dr. Ives has placed the flicker photometer on a sound basis, its foundation is none the less sound now, for this discussion shows little conflict between his data and those obtained by the writer.

M. Luckiesh,
Physical Laboratory National Electric Lamp Association.
Cleveland, Ohio.

Establishing the Date of Invention

To the Editors of the Electrical World:

Sirs:—Sooner or later inventors are apt to be called upon to prove when they made their inventions. Judging from hosts of cases, they are very delinquent in their efforts to establish competent evidence of the earliest date of invention. For example, one foolishly offers a notebook containing an undated, unwitnessed and almost illegible pencil sketch. Another confidently presents one or more witnesses, some of whom are not electrically educated and therefore do not even understand the invention. As an illustration of the inadequacy of personal testimony may be mentioned the noted telephone suit, where the testimony of scores of witnesses was counted for naught, thus giving Bell the victory. Another inventor exhibits documentary evidence acknowledged on a certain date before a notary public, but even such evidence is not absolute, especially if an opponent have more powerful proof.

"Why should one be so particular about clinching the date of invention simply because two inventors, by mere coincidence, occasionally make the same invention simultaneously?" one may ask. Allow me to answer that up to a few years ago there had been the astounding number of 25,000 interferences in the United States Patent Office. Besides, it is not unusual for a contest to take place between more than two applicants for patents. In one instance at least there were seven claimants; namely, such well-known electrical men as Schuyler S. Wheeler, Rudolph M. Hunter, H. Ward Leonard, Merle J. Wightman, Albert Blauvelt, James Burke and Granville T. Woods.

The discouraging consequences of not having competent evidence are the high cost of fighting an interference case before the Patent Office and the danger of losing the patent. Therefore, the date should be fixed so absolutely that the first inventor cannot, by any possible means, be deprived of the benefit of the date of invention or discovery. It is evident that if he is not obliged to be at the expense of proving such a date, the interference will cost him nothing. He can rest on his oars and let the others do the racing. He becomes entitled to the patent if no one else can prove an earlier date than his filing date.

So many inventions have undoubtedly been lost to the *really* first inventor, and appropriated by the *legally* first inventor, that it occurred to me that it must be a fact that many electrical men are unfortunately negligent in regard to protection, although so enthusiastic while creating their inventions. As the *Electrical World* readers probably include all electrical men, it seems to be a suitable medium in which to emphasize the point in their behalf that the only way in which to avoid the heavy cost of an interference, and yet prove the earliest date of one's invention, is to file the application for a patent in the Patent Office immediately after making the invention. The filing date becomes absolute evidence. Nothing can annul the efficiency of this date.

No consideration should stand in the way of securing the earliest official filing date.

Washington, D. C. Edward P. Thompson.

Fuse Economy

To the Editors of the Electrical World:

Sirs:—In connection with the statement which appeared on page 554 of the *Electrical World* for March 15 with regard to an analysis made by the writer of the claim that the use of reloadable inclosed fuses results in a large saving to the consumer, the following analysis may prove of interest.

From estimates made by some of the large users of inclosed fuses, it would seem that 10 per cent renewals a year is a fair estimate of the number of new fuses necessary in any well-regulated installation. It is possible that in a new installation, particularly of induction motors or railway motors, more fuses may be used for a short period after the installation has been made, owing to the fact that the particular conditions governing the installation may have rendered it difficult to select fuses of the proper capacity in the first place. As soon as these conditions are fully demonstrated from actual experience and fuses of proper capacity are installed the data would indicate that 10 per cent renewals per year is ample. If more than 10 per cent fuse renewals per year are being used, some attention should be given to the condition of the apparatus and the installation.

From the data available on reloadable inclosed fuses the list prices in most cases are practically double the prices of standard inclosed fuses, and the accompanying tables would indicate that with 10 per cent renewals a considerable number of years must elapse before a saving can be effected

TABLE I—COST OF 30-AMP, 250-VOLT FUSES AT LIST PRICE

	Reloadable		Standard	
100 fuses	At $0.50	$50.00	At $0.25	$25.00
End of first year, 10 per cent reloads.	At 0.03	0.30	At 0.25	2.50
Total		$50.30		$27.50
End of second year, 10 per cent reloads	At 0.03	0.30	At 0.25	2.50
Total		$50.60		$30.00
End of third year, 10 per cent reloads	At 0.03	0.30	At 0.25	2.50
Total		$50.90		$32.50
End of fourth year, 10 per cent reloads	At 0.03	0.30	At 0.25	2.50
Total		$51.20		$35.00
		Etc.		Etc.

by the use of the reloadable fuse. After this period of time, in all probability, the reloadable fuses are in such condition that from the standpoint of protection new fuses should be put in.

Table I is based on standard fuses of sizes up to 30 amp, 250 volts, which at the present time are not reloaded by the manufacturer. Table II is based on standard 200-amp, 250-volt fuses, which at the present time are reloaded by the manufacturer. It will be appreciated, of course, that the figures given for reloading the reloadable fuses do not include any labor or any filling material outside of the fuse links themselves.

It is the writer's belief, in spite of the fact that the saving is all on the side of the standard inclosed fuse, that the original cost of installation and the maintenance cost are matters of small moment considering the fact that a fuse which is reloaded in an improper manner by an irresponsible party may cause thousands of dollars of damage, as well as loss of life, such as might occur in case of a crowded sweatshop.

The writer believes also that the agitation which has

TABLE II—COST OF 200-AMP, 250-VOLT FUSES AT LIST PRICE

	Reloadable		Standard	
100 fuses	At $4.00	$400.00	At $2.00	$200.00
End of first year, 10 per cent reloads.	At 0.15	1.50	At 0.90	9.00
Total		$401.50		$209.00
End of second year, 10 per cent reloads	At 0.15	1.50	At 0.90	9.00
Total		$403.00		$218.00
End of third year, 10 per cent reloads.	At 0.15	1.50	At 0.90	9.00
Total		$404.50		$227.00
End of fourth year, 10 per cent reloads	At 0.15	1.50	At 0.90	9.00
Total		$406.00		$236.00
		Etc.		Etc.

come about through the pressure which has been brought to bear on the electrical committee of the National Fire Prevention Bureau has resulted in considerable good, as immediate thought will be given to so constructing the standard inclosed fuse that it will be practically impossible to reload it and that tampering can be readily detected. Moreover, it will probably result in the smaller fuses being reloaded by the manufacturer or an allowance being made for them if returned to the manufacturer.

Schenectady, N. Y. Howard R. Sargent.

Insulators of United States Navy Radio Station

To the Editors of the Electrical World:

Sirs:—In the article which appeared in the *Electrical World* April 5, 1913, under the title "United States Navy Wireless Station," referring to the service trials and operating features of the high-powered radio station at Arlington, Va., is the statement: "These antennas are all insulated by means of porcelain disks, such as are ordinarily employed in the construction of high-tension energy-transmission lines, arranged in series, as many as ten being employed to provide the necessary insulation."

In this connection attention should be called to the fact that for some months past electrose disk-type safety-strain insulators have been installed on the three towers of the above station in place of the porcelain insulators formerly employed. The very remarkable results recently achieved in both sending and receiving messages should therefore properly be credited to the later types of insulator. The insulators employed on the above towers are of the standard 7.5-in. disk safety-strain type, ten units being connected in series. The ultimate breakdown emf of each of the above insulator units is 50,000 volts, and the ultimate mechanical strength 20,000 lb.

It is noteworthy also that the Cruiser *Salem* is provided with electrose insulators of various types.

Louis Steinberger,
President and General Manager Electrose Manufacturing Company.

Brooklyn, N. Y.

Field of the Operating Engineer

A Record of Practice, Experience, New Ideas and Interesting Problems—Notes on Practical Subjects—Questions and Answers

Overload Test of Boiler at 250 per Cent of Rating

During a recent test the No. 12 boiler in the plant of the Narragansett Electric Lighting Company, Providence, R. I., produced for eight hours very nearly 250 per cent of its rated boiler-hp at an over-all efficiency of boiler and grate of 73 per cent. This test, which was witnessed by Messrs. James D. Andrew and Fred B. Freeman, of the Boston Elevated Railway; Charles W. Clarke, of the Stone & Webster Engineering Corporation; Arnold and Sarckey, of the Westinghouse Machine Company; M. Alpern, of the American Engineering Company; H. L. Breaker, of the B. F. Sturtevant Company; B. F. Allen, of Westinghouse, Church, Kerr & Company; J. Brown, of the Foster Superheater Company; William Pastell, superintendent of power stations of the Rhode Island Company, and M. W. Kern, of the Narragansett Electric Lighting Company, was made for the purpose of determining the capacity of a Riley self-dumping underfeed stoker of five retorts installed under the boiler.

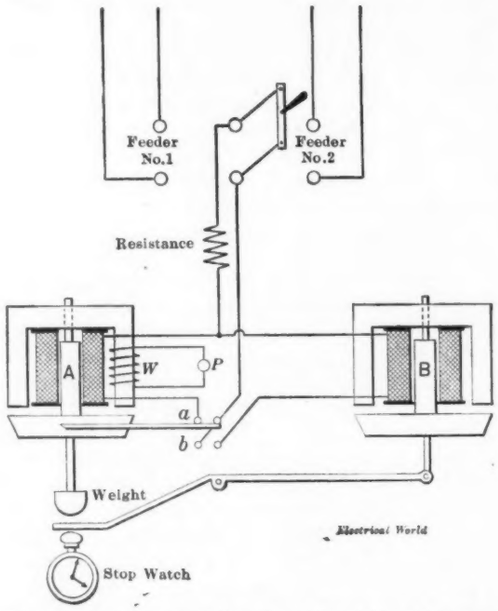
The boiler, which is twelve years old, is a Babcock & Wilcox unit, twelve tubes high, eighteen tubes wide and sixteen tubes long. No special effort was made to prepare it for this test. As a matter of fact, its companion boiler in the group of two was cold. The boiler was of such a size that a stoker of seven retorts could have been installed under it, which would have resulted in the burning of more fuel and a considerable increase in the capacity obtained. As the stoker is of the self-dumping type, working automatically, there was not the periodic dumping which is a necessary feature of other types; hence the steadiness of the steam pressure (174.1 lb. average) and other operating conditions. The fire appeared to be in the same condition from one end of the test to the other, all clinker being broken up automatically during its process of formation, and the boiler was kept on the regular line for some hours after the test. The total amount of coal consumed was 25,450 lb., or an average of 3181 lb. per hour. The water fed amounted to 251,170 lb., or an average of 31,396 lb. per hour, thus giving an evaporation of 9.87 lb. of water for each pound of coal. The water was fed at a temperature of 196 deg. Fahr., and the equivalent water evaporated per hour from and at 212 deg. Fahr. was 33,437 lb. per hour. This is equivalent to a total of 969.2 boiler-hp developed, which is 248.5 per cent of the builder's rating. The equivalent evaporation per pound of coal as fired was, then, 10.51 lb. of water, and the factor of evaporation was 1.065.

The coal analysis showed 74.13 per cent fixed carbon, 14.95 per cent volatile matter, 6.52 per cent ash and 4.40 per cent moisture. The calorimeter test determined the heating value to be 14,600 lb.-Fahr. units per pound when dry, or 13,957 units as fired. That the coal was thoroughly consumed is shown by the flue-gas analysis, which gave 16 per cent CO_2; 0.12 per cent CO, and 2.7 per cent oxygen.

At one time during the test a piece of 4-in. by 6-in. timber was purposely dropped into the center hopper to determine the effect upon the stoker. This timber, of course, blocked the plunger in that hopper and sheared the safety pin located on the connecting rod. The plunger was then automatically withdrawn from the stoker upon the return stroke of the connecting rod and left at its outermost position. Upon the removal of the obstruction and the insertion of the new pin, all of which was done without stopping the stoker, operation was resumed as if nothing had happened. The feed of coal into the middle retort was interrupted, of course, until the adjustment had been made. The power used by the blower was determined as 20 hp, while 1.4 hp was required to operate the stoker. Separate motors were used to drive blower and stoker.

Stop-Watch Record of Service Interruption

Often it becomes of importance to an operating company to know exactly the duration of a given service interruption when making explanations or dealing with municipal authorities, regulative bodies, customers, etc. The sketch shows an arrangement of a pair of relays and a stop-watch, which



RELAY OPERATION OF STOP WATCH RECORDING SERVICE INTERRUPTION

preserves an accurate record of the time the voltage is off the system. A device of this kind is now being used by the Yonkers (N. Y.) Electric Light & Power Company with thorough satisfaction.

Ordinarily, the relay *A* is in circuit, and it remains excited as long as potential is on the feeder. In case of an interruption *A* is de-energized, allowing its weighted armature to drop and deliver a slight blow on the stem of the stop-watch, setting the timing hand in motion. Incidentally the fall of the armature disconnects at *a* the circuit to relay *A*, bridging, instead, the relay *B* across the dead feeder. When service is restored *B* picks up, and its armature in closing presses on the watch stem through the crank arm, this time stopping the moving hand. Service interruptions are thus recorded with an accuracy down to one-fifth of a second.

A small pilot lamp, *P*, burns as long as relay *A* is in circuit, thus indicating at a glance that no service interruption has yet occurred. This little 2.5-volt lamp is supplied

with energy from secondary windings wrapped on the frame of relay *A*. An ordinary 8-cp lamp is used as resistance in series with the relays. By means of the double-pole double-throw switch, the recording device can be connected to either one of two feeder lines which it is desired to supervise. A pair of springs hold the stop-watch in place, minimizing jarring and helping to receive the blows of the falling weight and the relay movement.

Restoring Submerged Electrical Apparatus to Service After Flood

By GEORGE H. MORSE

The Ohio reached its high-water mark at Wheeling, W. Va., on March 29. Next day it receded sufficiently to uncover the electric generators and motors in the several plants belonging to a large steel and iron company, and the electrical engineer regularly employed being ill, the company sought the services of an outside expert in re-

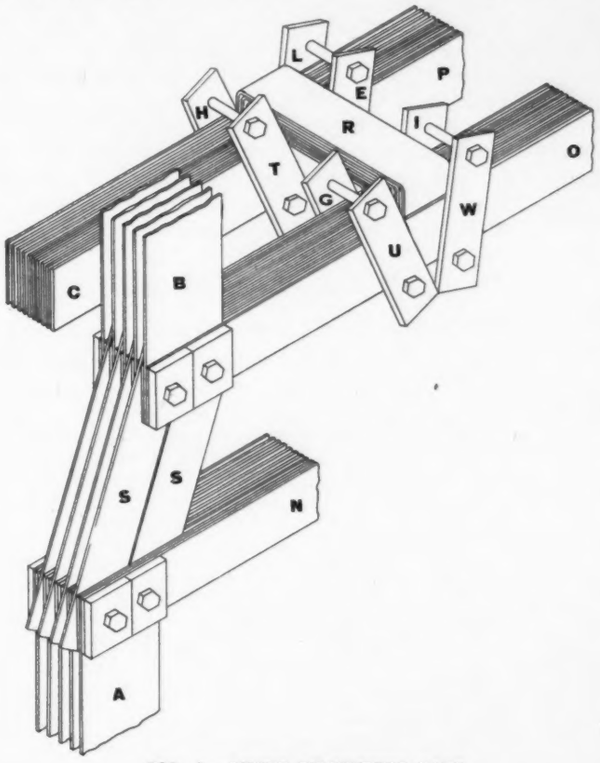


FIG. 1—SHORT-CIRCUITING BARS

storing service. The writer accordingly arrived on the scene at nine o'clock on the morning of March 31 and examined the 1000-kw, three-phase alternator shown in Fig. 3. The arrows to be seen on the rotor were painted there with white lead before the rotor was turned at all, in order that it might be known at all times just which coils had been under water. As the rotor stands in the picture, its upper part, from arrowhead to arrowhead, was immersed for several days, and of course a corresponding portion of the lower part of the stator was likewise under water.

The generator delivers 220 volts at 60 cycles, its normal full load per phase being 2600 amp. The first thing done was to place four large gas flames in the pit directly under the frame of the machine, in such position that the flames played against the iron surface, and the gas was kept burning for the following five days and nights. Two smaller direct-current units which had escaped inundation supplied energy at 125 volts, and this was led, through an improvised lamp bank and a number of rheostats, to the exciter field, the exciter's armature circuit being isolated and used to excite the field of the alternator after its engine was started. The same rheostat equipment was used in exciting the alternator from the 125-volt bus previous to starting its engine. Very perfect control was thus had of the current circulating through the rotor winding, and it was found possible to maintain the temperature of the

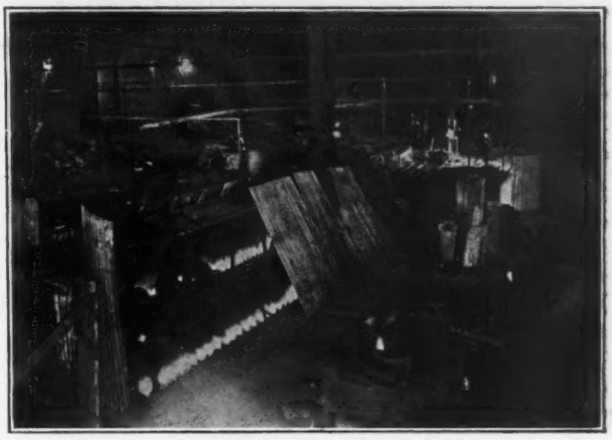


FIG. 2—DRYING ROTORS WITH GAS FLAME

latter just within the softening point of the insulation. The rotor was thus heated with electricity all of Monday and Monday night. Meantime a competent machinist was set to work to prepare the short-circuiting copper bars *S*, *S* and *R* shown in Fig. 1.

In this figure the busbar connections *C* and *B* are attached to the two circuit-breakers which protect the alternator and the third phase receives its current by way of connection *A*. *P*, *O* and *N* are the feeder ends of the busbars.

The short-circuiting pieces *S* and *S* take the place formerly occupied by blank spacers which were introduced to adapt the five members of terminal *A* to the ten members of busbar *N*, all being of the same thickness. The clamping pieces *H*, *L*, *E*, *G*, *I*, *W* and the bolts are of iron, while pieces *T* and *U* are of copper. The very material addition to the heating at connection *R* which a pair of complete magnetic circuits surrounding busbars *P* and *O*

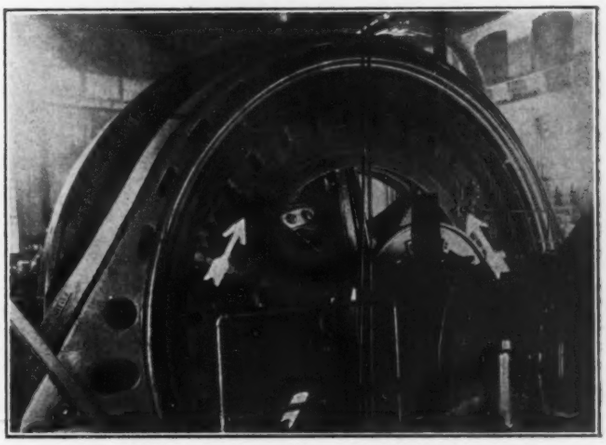


FIG. 3—WATER LINE ON THREE-PHASE ALTERNATOR

would have had if placed at points through which the short-circuit current was to flow was obviated by introducing these non-magnetic parts *T* and *U*. The machinist arrived at the plant at 5 o'clock Tuesday morning, bringing the short-circuiting copper which had taken him all night to make. Having put in position the eight bars at *S*, *S* and the nine U-shaped bars at *R*, the exciter was separately

excited, its current after starting the engine being cut down to nearly zero by means previously referred to.

It was soon found that normal full load of 2600 amp per phase produced but little heating effect and a current of 3300 amp, rising to 3500 at times, was maintained during a large part of the operation of drying out the stator. It

FIG. 4—TOP OF LARGE DRYING OVEN

was sometimes necessary, however, to reduce the current to 2500 amp when the stator became too hot.

The circuit-breakers heated considerably, as did the main switches and all busbar connections. Cloths wrung out of cold water were continually applied while compressed air and electric fans were used to cool the other parts. A large quantity of bare copper wire was wound between the circuit-breaker studs on the back of the switchboard in order to relieve them of a part of the current which they were carrying.

A large number of induction motors of all sizes up to 200 hp had been submerged. Fig. 4 shows the top of a large gas oven used for drying pipe before it is placed in the galvanizing tank, to be seen just at the left of the large motor on the right-hand side of the picture.

About fifty motors were placed, as ordered, upon this oven, those near the galvanizing tank being partially protected from excessive heat by a loose pavement of brick

FIG. 5—BRICK OVEN FOR DRYING DIRECT-CURRENT MACHINES

laid down for the purpose, while those above the cooler parts of the oven were covered with corrugated sheets found ready to hand.

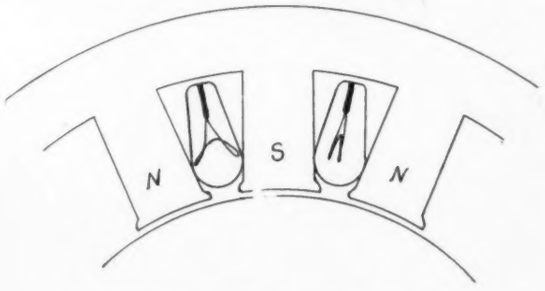
The stators of many of the larger motors were placed on their sides, a gas fire surrounded by a section of large pipe being placed at the center and corrugated sheets being used to protect the sides of the motors which had not been wetted. Three of the stators thus arranged are to be seen in Fig. 2. On the left of the same picture is a long line of rotors being heated by two parallel pipes at the floor level, holes having been bored every six inches to act at jets. In the picture a number of corrugated plates have been removed in order to expose the interior to view. The rule given the numerous attendants on duty day and night throughout the week was to keep all metal parts so hot that the hand could not comfortably bear the heat for more than ten seconds. Gaging of the temperature was by no means left entirely with the men, as the electrical engineer remained constantly at hand and made frequent rounds during the day and night. Fig. 5 shows the method used to dry large direct-current generators. Ovens of brick were built around the generator ends of these direct-connected units and each oven was served with two large gas jets. The temperature of the commutator was ascertained by feeling it from time to time and excessive heating avoided.

On Friday evening the short-circuit was removed from the large alternator. The stator and rotor were found free from grounds and the machine fully excited and the feeder circuits thrown on. The following morning heating of motors was ordered stopped and the motors were gradually returned to their places. On Sunday the direct-current generators had their brick ovens removed and were tested out. On Monday morning one week after the flood subsided all of the electrical equipment in all of the company's plants was ready for operation, without a single exception.

Testing Polarity of Field Coils

By E. R. Shepard

In testing the polarity of the poles of an alternator an ordinary carbon-filament lamp carrying a direct current was found to give very striking and definite results. By placing the lamp in the region of the leakage flux between



FILAMENT POSITION UNDER FLUX ACTION

adjacent pole tips the two loops of the filament will separate widely or draw close together, depending on the direction of the flux. By progressing around the fields with a lamp in this manner a reversed pole or a dead pole can be instantly detected. The behavior of the lamp is indicated in the accompanying illustration.

Atlantic Telegraph Cables

How many telegraphic cables are now embedded in the Atlantic Ocean? What voltage is used for signaling over these cables? R. J. L.

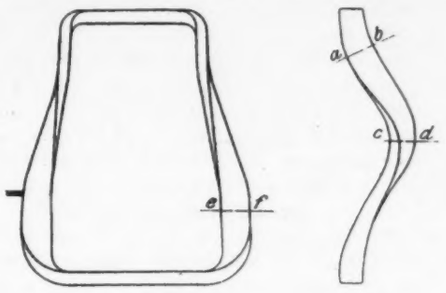
The transatlantic cables which are in service at the present are not embedded as you imply, but are strung in long spans upon the mountain peaks and high plateaus which protrude from the ocean's bottom. Fourteen such cables are now strung between American and European points. The potential used for signaling over these cables is approximately 50 volts.

Digest of Current Electrical Literature

Abstracts of Important Original Articles Appearing in the Periodical Electrical Press of the World

Generators, Motors and Transformers

Improvements of Two-Pole Rotor Windings.—KARL WELTZL.—An illustrated description of an improvement in the construction of two-pole rotor windings which results in a much more effective cooling so that the overload limit



EIG. 1—COIL FOR TWO-POLE WINDING

due to temperature rise can be advanced by 20 per cent to 25 per cent. Fig. 1 shows the form of the two-pole coil winding and Fig. 2 shows the wound drum. Both are self-explanatory. This form of winding can be used even with the smallest machines so that their ventilation becomes much better on account of the peculiar form of the coil heads. Attention is called especially to the ventilation space *V* in Fig. 2. In spite of the improved cooling effect the coils of this winding are smaller than the usual

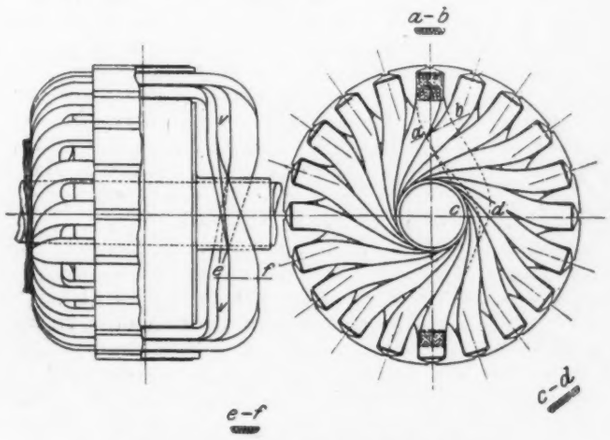


FIG. 2—WINDING OF TWO-POLE ROTOR

coils. They can easily be manufactured and mounted.—*Elek. Zeit.*, March 27, 1913.

Repulsion Motor.—E. SCHULZ.—A paper read before the Electrical Society of Cologne on small repulsion motors made by a German company. Their high starting torque is pointed out. In order to prevent the speed from increasing beyond a certain limit, a centrifugal switch is provided on the axle. It short-circuits three points of the armature winding when the machine has reached the limit of speed. The machine is then an induction motor running nearly at synchronous speed. Regulation of the speed of the repulsion motor is possible within rather wide limits by displacement of the brushes.—*Elek. Zeit.*, March 27, 1913.

Alternating-Current Commutator Motor.—A note on a recent British patent (No. 21,471, 1912) of the Siemens-Schuckert company. To improve the running of the motor a transformer is placed between the stator and the rotor. The transformer winding connected to the stator is joined in star, and that connected to the rotor is in mesh.—London *Elec. Eng'ing*, March 27, 1913.

Iron Losses.—J. WILD.—A thesis presented at the Institute of Technology at Stuttgart on the causes of the additional iron losses in rotating smooth-ring armatures.—No. 125 of *Mitteil. über Forschungsarbeiten auf d. Geb. d. Ingenieurwesens, insbes. aus d. Labor. d. techn. Hochschulen;* abstracted in *Elek. Zeit.*, March 27, 1913.

Lamps and Lighting

Flux and Light Intensity of Line Sources of Light.—K. NORDEN.—The formula of the flux from a linear source of light, as given by Pole, is $\varphi = \pi^2 HL$, where L is the length of the linear source of light and H the light intensity of the unit length measured in a direction perpendicular to the line source. This formula is correct. But the author states that Pole's statement that the calculation of the light flux from a linear source of light is indefinite as long as the surrounding illuminated surface is not given is a mistake. The spherical flux from any point, surface or body is definitely fixed under any circumstances. The mean spherical candle-power of a linear source of light is $HL\,\pi/4$; the mean hemispherical candle-power is also $HL\,\pi/4$. For the rating of incandescent lamps the horizontal candle-power is usually employed, and for metallic-filament lamps (without reflector) the ratio of the spherical to the horizontal candle-power is 0.79, which practically equals $\pi/4$. If, therefore, a metallic-filament lamp and a linear source of light have the same spherical intensity, the horizontal candle-power of the former corresponds to the total-length light intensity of the latter. The same is true for the hemispheric candle-power if the metallic-filament lamps are arranged horizontally, since in that case the mean hemispherical candle-power equals the mean spherical candle-power just as is the case with the linear source of light. Or, in other words, if a surface is to get a certain mean horizontal illumination and if the surface is large enough to absorb the whole hemispherical flux of the source of light, a horizontal linear source of light of L units of length with a candle-power of a candles perpendicular to the source of light is equivalent to L metallic-filament lamps, each of a candles, arranged horizontally.—*Elek. Zeit.*, March 13, 1913.

Street Lighting of Manchester.—S. L. PEARCE AND H. A. RATCLIFFE.—The street lighting of Manchester and the competition between gas and electricity are referred to generally. A description is given of a high-pressure gas and of a flame-arc installation. An account is given of the photometric work undertaken and comparisons are made between the rival systems. Relative costs, the physiological problems and the various types of globes, diffusers and reflectors are discussed. Sundry conclusions are stated. Purely from the point of view of illuminating effect there is much to be said in favor of both gas and electricity, but the electric-lighting system possesses all the practical advantages, a few of the more important of which are: (a) lower cost; (b) simplicity of switching operations and

possibility of dispensing with lamp-lighters; (c) flexibility and ease of erection; (d) lamps not affected by vibration when suspended from traction poles; (e) possibility of reliable check on running costs (that is, energy consumptions and electrodes); (f) negligible leakage; (g) absence of globe breakages due to heating, etc. All of the above advantages are absent in the case of the high-pressure gas system, and in contrast may be mentioned the disadvantages incidental to its use: (a) extensive and highly dangerous leakage of high-pressure gas; (b) the detrimental effect of a foggy or heavily smoke-laden atmosphere on the mantles, resulting in a serious diminution of candle-power just at a time when it is most required; (c) partial and occasional complete failure in frosty weather.—London *Electrician*, March 7 and 14, 1913.

Metallic-Filament Lamps for Lighting Street-Railway Cars.—Rau.—An abstract of a paper read before the Electrical Society of Cologne pointing out the advantages of tantalum lamps over carbon lamps for street-railway car lighting in Cologne. Experiments with the 1-watt osram lamp were also made for this purpose. (In an editorial footnote it is said that the osram lamp is being used successfully on the Berlin street railways).—*Elek. Zeit.*, March 27, 1913.

Hygienic Properties of Lamps.—de Recklinghausen.—An article on the hygienic properties of artificial sources of light and particularly of mercury-vapor lamps. As to the effect of ultraviolet rays emitted from mercury-vapor lamps (if not absorbed by the glass globe), they have no detrimental effect on human beings so long as the mercury-vapor lamp is at a sufficient distance. So long as they are installed at a considerable height no dangerous effect may be expected even if the globe should be accidentally broken. As to the greenish-blue color of the light of the mercury-vapor lamps, the author thinks that it is less fatiguing to the eye than that from other artificial sources of light. He finally discusses the distribution of light from lamps and expresses the opinion that a general application of indirect lighting is not the ideal solution of the lighting problem.—*La Lumière Elec.*, Feb. 22, 1913.

Arc Electrodes.—A note on a recent British patent (No. 15,483, 1912) of the British-Thomson Houston Company and the General Electric Company. To steady the magnetite arc the current is led into the electrode at right angles to the arc and in equal symmetrical branches. The positive electrode is of disk shape.—London *Elec. Eng'ing*, March 27, 1913.

Arc Producing Ultra-Violet Rays.—According to the *Engineer*, the Zeiss Optical Works have recently produced a rather curious form of apparatus. A so-called iron arc—that is, an electric arc with its electrodes impregnated with salts of iron—gives out light rich in ultra-violet rays. Then screens are used so as to cut off all the heating and luminous rays, leaving nothing but ultra-violet invisible radiations. In these pure ultra-violet radiations nearly all substances fluoresce, and the light they give out is greatly affected by the degree of their purity, so that this provides a new and very powerful means of examining the chemical purity of substances.—London *Electrician*, March 7, 1913.

Reflectors for Metallic-Filament Lamps.—L. Bloch.—An English translation in abstract of his recent German paper on special designs of reflectors for metallic-filament lamps for interior lighting.—London *Electrician*, March 21, 1913.

Generation, Transmission and Distribution

Economies in the Use of Electric Power.—W. E. Milns.—An illustrated abstract of a paper read before the Birmingham Section of the (British) Institution of Electrical Engineers. The heaviest item in a manufacturer's expenses is usually the wages bill. The power arrangements should therefore be designed to affect the wages account rather than the power account; that is, the designer of the arrangements for distributing power in a factory should not allow his engineering views to override the commercial considerations of the case. The author emphasizes that too much importance is usually attached to the cost of energy. "When a manufacturer asks for the cost of electricity per horse-power hour and says that such a figure will enable him with his own knowledge of his work to estimate his costs, it is wise to ignore the question. The author's experience is that the manufacturer has a very vague idea of horse-power, is ignorant of both his maximum and average load, and cannot estimate his horse-power-hours. A better method of estimating the cost of driving is based on figures actually obtained from existing manufacturers' installations." For the benefit of power users and engineers engaged in developing motor loads, the author gives some figures obtained from the analysis of power cost of gas, steam and electric driving in the same plant. The following figures are from a large pen factory, the owners of which have made very careful tests on the cost of steam, town gas, suction gas and electricity. The horse-power installed was 250. The cost of steam driving with Corliss compound condensing engines is $47.50 per hp per year; with gas from the corporation mains, at 35 cents per 1000 cu. ft., $36.04 per hp per year, and with suction gas $24.31 per hp per year. The cost of electric driving with energy at 2 cents per kw-hr. came to $18.43 per hp per year. These figures include energy maintenance, wages and repairs, interest, depreciation and all other charges. Another method of comparison which will appeal to a manufacturer with an elementary knowledge of engineering is to obtain load curves for the steam engines by means of continuous recorders, or from electric motors by means of recording ammeters, and to submit such curves to a power user. A last argument which, unfortunately, is rarely taken into consideration is that the conditions of labor and employment in electrically equipped factories are usually far superior to those found in works utilizing any other form of power.—London *Electrician*, March 14, 1913.

Energy Supply on the Rand.—A. E. Hadley.—A paper read before the (British) Institution of Electrical Engineers. Particulars are given of the Victoria Falls and Transvaal Power Company and of the history of electric energy supply on the Rand. Details are given of the transmission system and of the Rosherville station, together with some account of the substations and a compressed air supply scheme.—London *Electrician*, March 14 and 21, 1913. An editorial discussing one special feature in Hadley's paper, namely, the use of reactors in alternating-current systems.—London *Electrican*, March 21, 1913.

Independent Steam-Condensing Plants.—W. A. Dexter.—An illustrated paper in abstract, presented before the New Castle section of the (British) Institution of Electrical Engineers, giving comparative notes on independent steam-condensing plants. Surface and jet-condensing plants are discussed and compared, chiefly those used in connection with steam turbines. Air-pumps are also considered, both reciprocating and rotary, with some remarks incidental to their efficient working and maintenance.—London *Electrician*, March 28, 1913.

Diesel Engine.—J. H. Bauer.—A long paper read before the Electrical Society of Cologne on the Diesel engine, the kinds of oil which can be used for its operation, and the economical results obtainable in commercial work.—*Elek. Zeit.*, March 20, 1913.

Traction

Single-Phase Alternating-Current Commutator-Motors for Railways.—M. Latour.—An illustrated English translation in abstract of his article in *Elektrotechnik und Maschinenbau* and *Elektrotechnische Zeitschrift*. The various types of single-phase commutator motors tested by the Compagnie des Chemins de Fer du Midi are compared, especially those which possess a cross-flux, either

as an inherent property (repulsion motors) or produced artificially (series motors). The superiority of the series motor with a resistance in parallel with the auxiliary pole is shown. Use is made of the current diagram, which enables the interpole excitation to be calculated for this arrangement. Finally an equivalent arrangement is given whereby all complications in the construction of the motor are avoided and a desirable degree of simplicity is obtained. London *Electrician*, March 28, 1913.

Installations, Systems and Appliances

Electricity Supply in Bavaria.—Tillmetz.—A long abstract of a paper by Ph. Arnold in the *Zeit. d. k. Bayer. Statist. Landesamts* on the use of electricity in Bavaria with special reference to Munich and suburbs. The first part deals with the uses of electricity in general, the second with the uses of electricity in factories and workshops, and the third with the uses of electricity in agriculture. A great many statistical figures are given.—*Elek. Zeit.*, March 27, 1913.

German Electrical Industries.—A continuation of the reviews of the status of the different fields of the German electrical industry in 1912. Bercovitz-Schmiedel discusses measuring instruments and methods including meters, P. Humaun overhead conductors and underground cables for heavy currents and the manufacture of cables, A. Steinhaus electric lighting (see abstract above), A. Steinhardt electric heating and cooking, Thierbach electric drives in factories, Krohne the applications of electricity in agriculture.—*Elek. Zeit.*, March 27, 1913.

Electrochemistry and Batteries

Advantages of Small High-Speed Electric Furnace.—Carl Hering.—A paper pointing out the importance of the rate (speed) of melting on the economic results obtainable with an electric furnace. Calculations are given for a series of brass furnaces operated with the same charge but at different rates of melting, and also the results for a series of brass furnaces operated with the same rate but with different charges. The results are shown by means of diagrams. With a given furnace of any stated capacity of hearth it pays well to force it as much as other conditions permit. For the same rate of melting the smaller the furnace the more economical it will be in energy consumption.—*Metall. and Chem. Eng'ing*, April, 1913.

Measuring the Density of Storage Battery Acid.—F. E. Kretzschmar.—To determine the condition of charge or discharge of a storage battery the measurement of the density of the acid is the simplest means. In order to make use of an aerometer particularly convenient and suitable for this purpose, the author has devised a simple arrangement for mounting the aerometer in the battery, a magnifying concave mirror being mounted at an angle of 45 deg., which permits one to read the aerometer scale directly from above in the mirror.—*Elek. Zeit.*, March 27, 1913.

Units, Measurements and Instruments

Electrical Units.—R. T. Glazebrook.—A Kelvin lecture delivered before the (British) Institution of Electrical Engineers on "The Ohm, the Ampere and the Volt—a Memory of Fifty Years, 1862 to 1912." The historical sketch given is concise and seems complete. The same issue contains a long editorial on the fundamental electrical units.—London *Electrician*, March 7, 1913.

Units and Notation.—A joint committee of various technical and scientific German societies (including the German Association of Electrical Engineers) proposed changes in the notation of units. A list of these units and their notation is given with explanations by K. Scheel and K. Strecker.—*Elek. Zeit.*, March 13, 1913.

Series Transformer.—A. R. Anderson and H. R. Woodrow.—A bulletin of forty-five pages on the characteristics and limitations of the series transformer. The authors give a discussion of the fundamental principles of the series transformer and a representation by vector diagrams of its operation. A deduction of current relations by the method of complex quantities and a discussion of conclusions that may be derived therefrom follow. The derivation of current relations by the use of instantaneous current values is then given, particular stress being laid upon the application of the series transformer for the purpose of recording transient phenomena. Some of the most general and important results of their investigation are as follows: The transformation ratio and phase angle of a series transformer having a core of constant permeability (such as air) are constant under given conditions for all values of primary current, but this is not so with a transformer having an iron core. With an iron-cored series transformer the form of variation depends upon the shape of the saturation curve and upon the range over which the transformer operates. The range over which the permeability remains most nearly constant is the range over which the ratio remains most nearly constant. In a transformer of constant core reluctance the so-called magnetizing current is proportional to the primary current and its phase position is constant. The introduction of resistance in the secondary circuit of a series transformer has the effect of increasing the phase angle, and this increase in phase angle is practically proportional to the secondary resistance for reasonable values. Increasing the secondary resistance decreases only slightly the transformation ratio. Hence, in general, the introduction of secondary resistance is very objectionable when the transformer supplies current for a wattmeter, but is not seriously objectionable when the transformer supplies current for an ammeter. The effect of secondary reactance and the equivalent effect of magnetic leakage is to reduce the phase angle slightly and the transformation ratio very considerably. The phase angle increases with decreased permeability, and consequently in a transformer with an iron core the phase angle increases as the line current decreases. The effect of changes in frequency within a range of 10 cycles is not generally serious. However, in addition to the effects of frequency, in a transformer with an iron core, decreasing the frequency raises the point of operation on the saturation curve and hence increases the core loss and alters the form of variation of transformation ratio and phase angle with primary current. The desirability of a high number of turns is pointed out. With a reasonably high number of turns and a not excessive value of secondary resistance the effect of frequency over a considerable range is negligible. The effect of core loss is to decrease the secondary current, this effect being lessened by inductive secondary load. Increased core loss decreases the phase angles, and this effect is increased by inductive secondary load. In an iron-core series transformer the value of flux density should be low (say $B = 2000$ at full load). This means a low value of magnetizing current. To this end excessive secondary impedance should be avoided, as increased impedance requires an increase in flux in practically direct proportion to the impedance. Since the effect of magnetic leakage is equivalent to the effect of secondary reactance, the transformer should be designed with a view to minimum magnetic leakage. This requires a well-closed iron circuit. For recording instantaneous values of current in transient or unsymmetrical currents the commercial series transformer with an iron core is quite inadequate and cannot be relied upon. If necessity demand the use of a series transformer in recording transient or unsymmetrical currents, an air-core transformer, designed to have a very small secondary resistance and a large secondary reactance, will be found to give results nearer to those desired than can be got by making use of an iron-core transformer.—*Univ. of Ill. Bulletin*, No. 61 (Vol. 10, No. 9).

Telegraphy, Telephony and Instruments

Transposition of Wires in Telephone Cables.—F. Lange.—A paper on an investigation carried out by the German government telegraph experimental station. The author points out that the opinions of experts do not yet agree as to the best way of arranging the transposition of the wires in telephone cables carrying a number of pairs of wires, in order to prevent "cross-talking." Generally, transposition is considered to be most favorable if the distances between two complete turns are short. This is, for instance, American practice. On the other hand, another method is also used in which the distances between complete turns are made longer but are varied from pair to pair. The author compares the methods. In the present paper only the induction effects are considered. On the basis of the formula of the mutual inductance between parallel conductors a formula is derived for the mutual inductance of parallel conductors with transposition, the transposition being uniform and in the same direction and long distances between complete turns being used. It is found that the coefficient of mutual inductance equals zero only if the phases of the transposition are in quadrature as shown in Fig. 2. This represents successive cross-sections through two pairs of conductors side by side and the two planes through the pairs of conductors are always perpendicular to each other. A change in the distance between complete turns from pair to pair always improves the protection against induction. The results of measurements of the differences of the partial capacities of such pairs which show a particularly strong mutual effect on each other prove that when cross-talking takes place there are usually capacity differences.—*Elek. Zeit.*, March 20, 1913.

FIG. 3—CROSS-SECTIONS THROUGH TWO PAIRS OF CONDUCTORS

Semi-Automatic Telephony.—Grabe.—An illustrated description of the semi-automatic telephone exchange system of the Siemens & Halske Company.—*Elek. Zeit.*, March 27, 1913.

Wave Detector.—A note on an investigation by Leithäuser on the application of the unilateral conductivity of flames to the design of a central wave detector. The experimental apparatus employed comprised a small induction coil connected to a 5-mm gap between two 1.5-m wires with end capacity plates. At a distance of from 33 ft. to 65 ft. a similar receiving circuit was connected to the electrodes of a flame detector. A Bee-Meker burner was used to provide a steady flame of great intensity, with a small bright blue inner cone. The electrodes used were a 1-mm copper wire and a ring of sheet platinum covered with a potassium salt (the object of which was simply to increase the conductivity of the flame). These electrodes were connected through a high-resistance telephone to the terminals of a resistor of some few ohms resistance across which a suitable potential difference could be maintained and varied by a local battery in series with an adjustable resistor. Later, a high-sensitivity moving-coil galvanometer was also connected in the detector circuit and at times the telephone was replaced by an Edelmann vibration galvanometer. Experiments showed that the efficacy of the detector depended largely on the dimensions and relative positions of the electrodes and on the size of the flame and its temperature around about the electrodes. A current-voltage curve was prepared when working under the most favorable adjustments, and the steep rise and sharp change of the current proved the rectifying action of the detector to be very pronounced. That phase corresponding to which the platinum electrode was positive was almost entirely suppressed, but the other phase was carried with high conductivity. The delicacy of the detector was at least equal to that of a sensitive electrolytic valve and was usually greater.—*Phys. Zeit.*, No. 18, 1912, and *Zeit. f. Schwachstromtechnik*, No. 2, 1913; abstracted in London *Elec. Review*, March 14, 1913.

Electrolytic Detectors.—Paul Jagou.—A paper on the phenomena taking place in an electrolytic detector without auxiliary emf. A theory of the operation of electrolytic detectors is given.—*Comptes Rendus*, Feb. 3, 1913; abstracted in *La Lumière Elec.*, Feb. 22, 1913.

Slide Rule for Wireless Telegraphy.—A description of a simple modification of the ordinary slide rule by which it is rendered possible to make in a quick and simple way the complicated calculations needed in wireless telegraphy.—*Elek. Zeit.*, March 20, 1913.

Horizontal Antennas.—Louis Cohen.—A conclusion of his mathematical paper on the inductance and capacity of linear systems of conductors. In the present instalment he applies the method to the determination of the inductance and capacity of horizontal antennas.—London *Electrician*, Feb. 21, 1913.

Miscellaneous

German Association of Electrical Engineers.—The twenty-first annual meeting will be held in Breslau from June 18 to 21. E. Frischmuth will present an address on the economical importance of electric traction of trunk railways. Reports will be presented by S. Ruppel on protection of houses against lightning, by Weidig and Jaensch on phenomena on high-tension overhead lines, and by Monasch on modern electric lamps. A discussion of the distribution of large amounts of energy over extended districts will be opened by an address by G. Klingenberg. There will be a large number of excursions.—*Elek. Zeit.*, March 27, 1913.

Book Reviews

Studies in Light Production. By R. A. Houstoun, M.S. New York: D. Van Nostrand Company. 116 pages, 22 illus. Price, $2.

The book is virtually a lengthy essay on the fundamental scientific principles of luminous sources compiled and collated by the author from the technical literature of the past fifteen years. The plan of the work is thus mainly systematic and historic. The twelve chapters of the book relate to the following subjects: The energy spectrum, the black body, flames, the Welsbach mantle, the carbon glow lamp, the arc, the nernst lamp, metal-filament lamps, the mercury arc, the light of the future, on the absolute measurement of light, apparatus and experimental methods. The book is more than a mere compilation. It contains some new experimental data and treats the subject in a very logical manner. The chapter on the absolute measurement of light is especially original in treatment. The book will be useful to advanced students of the theory of light.

Essentials of Electricity. A textbook for wiremen and the electrical trades. Direct Currents. By W. H. Timbie. New York: John Wiley & Sons. 272 pages, illus. Price, $1.25.

A very elementary textbook of applied electricity suitable for the use of wiremen, electric artisans and all who desire to acquaint themselves with the fundamental principles of electricity without the use of mathematics beyond simple arithmetic. The book is divided into nine chapters on the following subjects: Ohm's law, simple electric circuits, combinations of series and parallel systems, electric power, wire and wiring systems, generators and motors, locating and correcting "troubles," batteries, wiring diagrams. A number of easy numerical problems for solution are scattered throughout the work.

New Apparatus and Appliances

An Illustrated Descriptive Record of Recently Developed Manufactured Products of Interest to Electrical Readers

Luminous-Bowl Indirect-Lighting Fixtures

The Hub, Chicago, a store devoted to the sale of men's clothing and furnishings, occupies the first eight floors and basement of the Lytton Building and is equipped throughout, except on the eighth floor, with the so-called

FIG. 1 — MAIN FLOOR OF THE HUB STORE, LIGHTED BY LUMINOUS-BOWL INDIRECT FIXTURES

"eye-comfort lighting system" of the National X-Ray Reflector Company, Chicago.

The installation on the ground floor is said to be the first luminous-bowl indirect-lighting system. The manufacturer claims that the reason for the existence of the

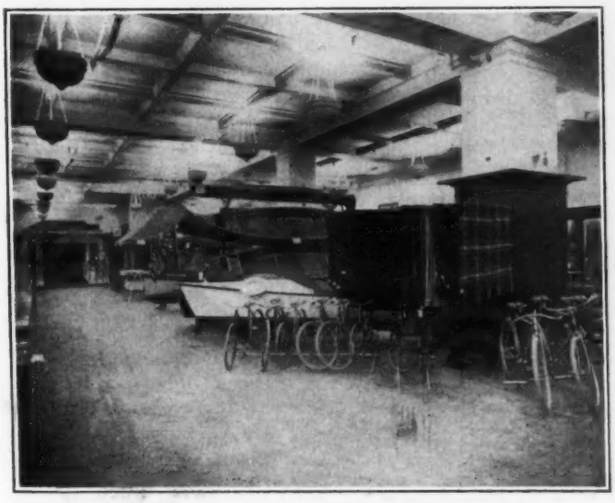


FIG. 2—PLAIN INDIRECT FIXTURES IN THE HUB STORE

so-called semi-indirect lighting is that while people want indirect lighting, they also want to see where the indirect light comes from.

With the so-called "eye-comfort lighting system" the indirect light is obtained with a standard X-ray reflector equipment, and the luminous-bowl effect is obtained by screwing into a socket in the bottom of the central body of the equipment for indirect lighting a low-wattage lamp which softly illumines the glass bowl. It is said that in this manner the high efficiency of the indirect-lighting system is retained and no usable light comes through the glass bowl.

Single-Phase Induction Watt-Hour Meter

In a single-phase induction-type watt-hour meter which has recently been put on the market by the Holcomb & Hoke Manufacturing Company of Indianapolis there are some interesting features. Two of these relate to the design and arrangement of the rotating element and of the permanent magnets. The rotating element is an aluminum disk of small size but of sufficient thickness to give it great

METHOD OF REMOVING JEWEL POST AND ROTATING ELEMENT

strength in proportion to its weight. This disk is mounted on a short shaft, pivoted at top and bottom, and the entire moving element has a low center of gravity. The short shaft and the stiffness and strength of the disk are calculated to give protection against bending by accident or short-circuits. The top pivot is a spring-tempered piece of steel wire set in the shaft, and it will resist bending due to accidental rough handling or short-circuits.

For inspection or repair the rotating element can be removed from the meter without disturbing any other part. No tools are necessary for this work, the process being simply to throw back the spring at the bottom of the pivot post, pull down and remove the jewel post, lift the top of the shaft, and the rotor is then immediately removable by simply slipping it out. A damaged jewel or rotor can therefore be replaced easily without disturbing the adjustment of the meter in any way.

The permanent magnet has a single long tempered steel magnetic circuit with a single air-gap, and it is declared that this design will give a stable, steady magnetic field with a minimum amount of demagnetization. The magnet is removable from the meter by simply loosening the holding screws at the top without disturbing any other part of the mechanism, and all magnets are interchangeable. It is provided with a coarse, quick adjustment and a fine micrometer adjustment for full-load calibrating. The final adjustment is against a stop which acts as a gage, so that the permanent magnet when once set may be taken off for inspection and cleaning and replaced in exactly the former position without any necessity for recalibration. The light-load adjustment is also a micrometer adjustment against a gage.

The complete meter is light in weight but strongly made, with case of pressed metal. The weight of the 5-amp size is 5½ lb. The meter is provided with a full glass front and the method of sealing in combination with the design of the case is such as to prevent tampering of any kind with the meter. The H. & H. meter was designed and is being manufactured under the supervision of Mr. G. A. Scheeffer, known to the electrical industry as the inventor of the first induction-type watt-hour meter on the market.

Composition-Glass Reflector

The Holophane Works of General Electric Company, Cleveland, Ohio, have just placed on the market a new product called the "Sudan glass reflectors in panelex design." The glass is said to be of a new chemical composition, of very delicate amber tint when lighted, and translucent. Its smooth surface, which is said to be practically dustproof, has no polish or glare. The design of this reflector is without marked ribs or hollows that would catch and hold dust, and the lamp filament is hidden from the ordinary line of vision. This reflector is said to demonstrate the large possibilities of light diffusion and redirection without loss of artistic effect.

BOWL-TYPE REFLECTOR

The reflectors are made in both the bowl and shallow types and are particularly adaptable for use in office buildings, retail stores and some rooms of residences.

Miniature Precision Instruments

The Weston Electrical Instrument Company, of Newark, N. J., has recently placed upon the market a line of miniature direct-current instruments of the permanent-magnet movable-coil type, in both portable and switchboard forms.

The line comprises voltmeters, battery-testing voltmeters, ammeters, volt-ammeters, millivoltmeters and milliampere meters, in various combinations of single, double and triple ranges. They are finished in dull black, with nickel-plated trimmings.

The outside dimensions of the portable form are 4.4 in. by 4.6 in. They weigh less than 1 lb. each and may easily be carried in the pocket. They have a knife-edged pointer, which enables close readings to be made. The scale has a length of 2¾ in.

The working life of an instrument depends on the proper design of the movable system, which must be very light and at the same time rigid, and the spring torque must be high in comparison to the weight and moment of inertia. The movable system in these miniature instruments weighs less than 0.2 gram (less than the weight of two ordinary pins), and its parts are so well distributed that the time required for the pointer to come to rest after the application of or a change in the current or voltage is about 0.2 second, which for all practical purposes is instantaneous. The movement of the pointer is damped, "dead-beat," by means of the aluminum frame on which the wire forming the movable coil is wound, in a manner similar to that in the larger types of Weston instruments.

It is stated that this line of instruments has been subjected to the most severe conditions in use, and that they are being successfully employed on the dashboards of automobiles, where the vibration and jar are far in excess of that which would be encountered in ordinary testing. Both portable and switchboard forms are shielded against external magnetic fields and are practically unaffected by changes in temperature.

By means of a triple-range portable voltammeter any direct current from 30 amp to 0.05 amp and any emf from 150 volts to 0.02 volt can be measured. The switchboard form of meter has the same general characteristics as the portable form. A switchboard voltammeter is designed for use with storage-battery charging outfits on or for automobiles and with other small storage-battery installations where it is desired to use a single instrument to indicate both volts and amperes. It indicates the charging or discharging current, and on pressing the contact button it indicates the voltage of the cell or battery.

VOLTMETER FOR BATTERY TESTING

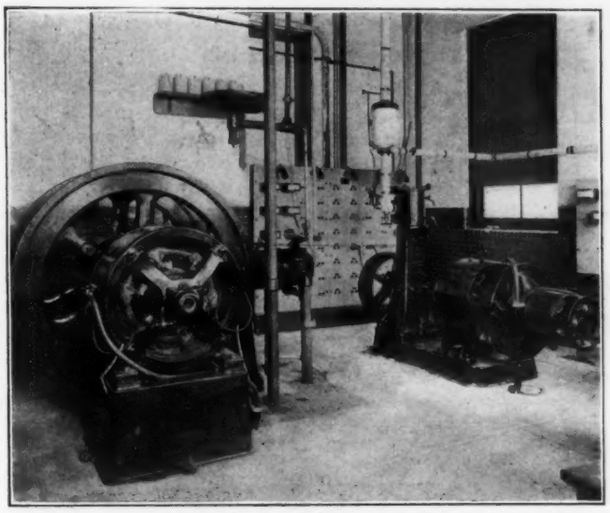
The battery-testing voltmeter shown herewith is provided with a steel point as one of the terminals to facilitate making contact to one of the plates or terminals of the cell to be tested. The other terminal consists of a flexible lead also provided with a point. They have knife-edge pointers and are made with the zero in the center, so that the voltage may be read regardless of the polarity.

Electrical Laboratory for High School

Modern high schools and academic institutions, more especially those where manual training is a part of the curriculum, are installing completely equipped electrical laboratories for the benefit of students. The illustration shows a corner of the electrical laboratory of the West Philadelphia High School, Philadelphia. On the left is shown a 10-kw, 125-volt, 250-r.p.m. direct-current generator coupled to an Otto gas engine. On the right is shown a 10-kw, 125-volt, 400-r.p.m. 60-cycle, single-phase alternating-current generator, on the shaft extension of which is mounted a 1⅛-kw exciter. This apparatus is mounted on the same bedplate with and coupled to an A B C steam engine. Students are thus enabled to study the characteristics of both alternating-current and direct-current generation and can observe the relative merits of steam and gas-engine drive.

The switchboard consists of three panels, on which are mounted the necessary instruments, field rheostats,

switches, ammeters, voltmeters, wattmeters, etc. The panel on the left controls the output of the direct-current generating set and the one on the right the alternating-current set. The central panel acts as a neutral distributing board having receptacle inlets numbered identically with those in the alternating-current and direct-current

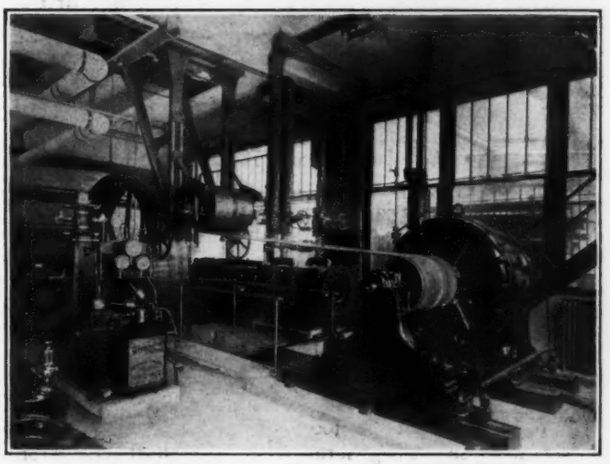


ELECTRICAL LABORATORY OF WEST PHILADELPHIA HIGH SCHOOL

boards respectively. These numbers correspond with receptacles placed at convenient points about the laboratory and in close proximity to the students' benches.

Two-Speed Motor Drive for Refrigerating Machine

The advantages of motor drive for refrigerating machinery are so conspicuous that motors are now used whenever the conditions permit. The accompanying illustration of a motor-driven refrigerating machine in a large brewery shows the simplicity, compactness and cleanliness of such an installation. Another important advantage is the fact that



MOTOR-DRIVEN REFRIGERATING MACHINE

the motor requires practically no attendance. It runs continuously without other attention than an occasional oiling.

This particular installation is especially interesting, however, because the motor is a two-speed alternating-current machine and can be operated at either 495 r.p.m., developing 225 hp, or at 247 r.p.m., developing 113 hp, and it is said it will operate at equally high efficiency at both speeds. Consequently, in cold weather the refrigerating machine can be run at low speed with a considerable saving in operating expenses.

The refrigerating machine shown is a De La Vergne horizontal ammonia compressor, with a freezing capacity of 125 tons of ice in twenty-four hours. The motor is manufactured by the Westinghouse Electric & Manufacturing Company.

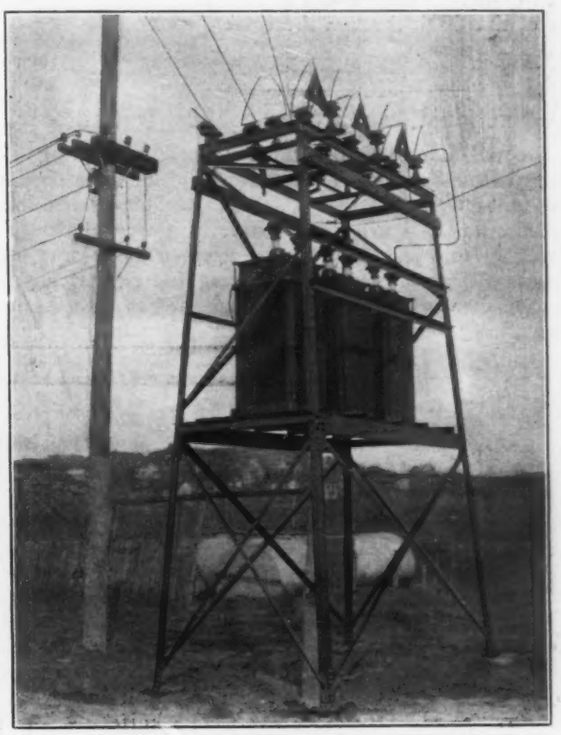
Outdoor Substations

High-tension transmission lines are often erected near small towns or industrial plants which wish to purchase energy in comparatively small amounts. To provide such service, any equipment used must be very low in cost and yet must meet very rigid requirements. The station must operate without constant attendance; if serious trouble occurs, the equipment must be automatically disconnected from the line; provision must be made to disconnect the high-tension circuit when inspection or repairs are required, and finally, the main-line service must not be subjected to interruption.

In order to meet such conditions the Penn Public Service Company, Clearfield, Pa., has installed at many places along the transmission lines outdoor-type substations, one of which is shown in the illustration.

The equipment of this station consists of three 100-kva Westinghouse outdoor-type 22,000-2300-volt transformers supported on a special tower which is constructed of structural steel.

Concrete footings are provided and in assembling the steelwork bolts are used instead of rivets, thus simplifying the erection. Burke horn-gap switches are used so that it

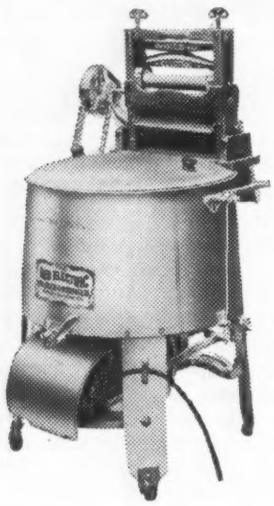


OUTDOOR TRANSFORMER INSTALLATION

is possible to open the high-tension line under load, and protection for the main line is gained by using horn-gap fuses which will blow if serious trouble occurs in the transformer or on the low-tension lines. Triangular choke-coils, with horn-gaps to ground, protect the transformers from lightning.

Washing and Wringing Machine

The so-called "Red Electric" washing and wringing machine, which is made by the Hurley Machine Company, South Clinton and Monroe Streets, Chicago, is claimed to be absolutely water-tight and rust-proof. The tub is made of galvanized sheet steel, and the machinery which is placed

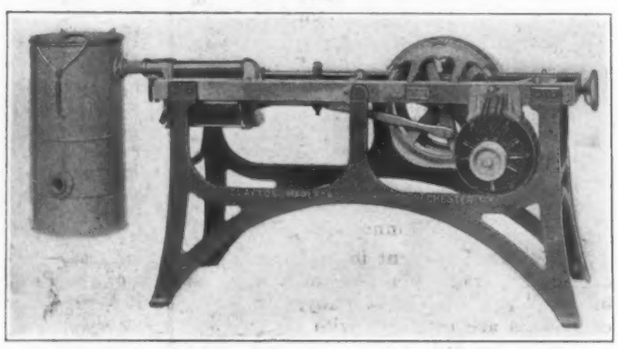


ELECTRIC WASHING MACHINE

below the tub is protected by a galvanized-steel shield. The two-roll reversible wringer, which is of a comparatively new design, is operated by a ⅛-hp motor. This motor can operate simultaneously both the washer and the wringer if desired. All the machinery is out of the operator's way and the top of the machine can be used as a table when running the clothes back through the rinsing water.

Suction Cleaner with a Multi-Duty Motor

The usefulness of the small electric motor for doing many of the hard, disagreeable tasks around the home has become so well recognized that one suction cleaner manufacturer has designed his machine in a way allowing full advantage to be taken of the motor when the cleaner is not in use. When the motor is driving the cleaner a pinion on the inner end of the motor shaft meshes with the large gear wheel, which operates the air pump through a con-



MOTOR-DRIVEN SUCTION CLEANER

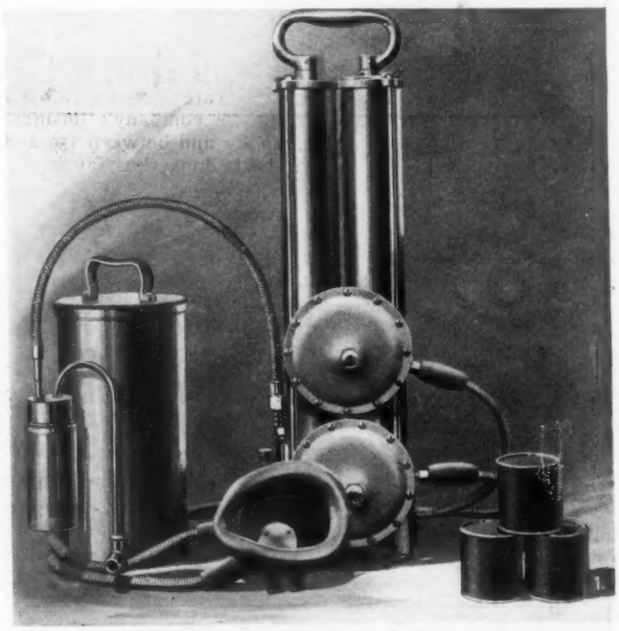
necting rod. To make the motor available for other purposes, the hand-wheel on the end of the cleaner frame is turned, thereby drawing the motor forward and disengaging the pinion. A pulley on the outer end of the motor shaft provides means for belt drive.

The cleaner, being of the stationary type, has pipe connections to outlets on each floor to which the hose with the cleaning tool is attached. The motor can be controlled from any floor.

The cleaner is manufactured by the Clayton-Marlborough Manufacturing Company, Rochester, N. Y., the electrical equipment being furnished by Westinghouse Electric & Manufacturing Company.

Lungmotor for Resuscitation

An artificial respirator, called the lungmotor, weighing less than 25 lb. complete in a strong carrying case, is being manufactured by the Life Saving Devices Company, of Chicago. The apparatus is operated by hand power and consists of a mechanical pump, an oxygen generator and a rubber face mask with the necessary connecting tubing. The pump has two cylinders, one for supplying a mixture of air and oxygen to the subject and the other for removing devitalized air from the patient's lungs. Any desired mixture of air and oxygen can be obtained by adjusting a valve, and the manufacturer says that danger of excessive pressure in the patient's lungs is prevented by diaphragm



ARTIFICIAL RESPIRATOR AND OXYGEN GENERATOR

valves located between the pump and the face mask. An indicating dial on the top of the pump can be set to limit the stroke of the pistons, thus regulating the volume of air according to the requirements of the individual under treatment. Oxygen is generated in the small portable tank shown on the left of the picture by the action of water on fused sodium peroxide, and any minor impurities which may exist in the gas are taken out in a washing bottle fastened to the side of the generating tank. The sodium peroxide is furnished in sealed cartridges which will last from thirty-six to sixty minutes according to the amount of oxygen required. Two flexible tubes connect the pump cylinders with the face mask. An upward movement of the handle of the lungmotor draws oxygen and air into one cylinder and at the same time empties the patient's lungs of air. The reverse movement of the handle pumps fresh air into the lungs.

One of the advantages of this device, as stated by Mr. F. T. Fowler, is that when the subject struggles for breath the operator can help him by manipulating the handle of the pump without removing the face mask. In case the supply of oxygen gives out, the lungmotor can still be used with air alone.

Industrial and Financial News

Public Utility, Commercial, Corporate and Trade Developments—The Electrical Material and Security Markets

Change in Distributing Policy of Holophane Works.—In order to promote closer relations between itself and electrical supply jobbers, the Holophane Works of General Electric Company has instituted a new policy for distributing its commercial types of glassware. Commercial glassware will no longer be kept in stock at the company's district offices, but will be kept on sale at the offices of electrical supply jobbers. The policy of the company in handling its ornamental type of glassware is contrary to that of many other manufacturers in the same line of business as itself, in that the ornamental glassware is being sold through the medium of fixture manufacturers. The fixtures used in connection with its glassware are not marketed by the Holophane Works, but this business is diverted to the fixture manufacturers, who, the company feels, are the logical distributers of the complete ornamental fixtures and glassware, inasmuch as it is the fixture manufacturer with whom architects co-operate in designing the decorative features of buildings. The company's business in steel reflectors is expanding rapidly and between 150 and 200 per cent more business has been done thus far in the current year than was the case in the corresponding period of 1912. On this account it has been found necessary to erect a new factory in Cleveland for the manufacture of steel reflectors. The factory building, which is nearly completed, is 320 ft. long by 80 ft. wide. Two floors of it will be used in manufacturing the reflectors. The metal-reflector manufacturing carried on heretofore at Newark, Ohio, is to be transferred to the new plant.

Allis-Chalmers Manufacturing Company Begins Operations.—The Allis-Chalmers Manufacturing Company, which was formed recently to succeed the Allis-Chalmers Company as a result of the reorganization of the latter, as noted in these columns March 22, took over the properties and began operations on April 16. J. H. McClement, chairman of the board of directors of the Allis-Chalmers Manufacturing Company, stated to a representative of the *Electrical World* this week that the receiver would be discharged shortly. He said, also, that no changes whatever are contemplated in the personnel of any of the departments of the former Allis-Chalmers Company. The business of the company during the receivership has been very good. During February, under Receiver Falk, a balance of $37,000, after $35,000 depreciation, was earned. The net earnings in January, after the same amount for depreciation, were $10,000. Otto H. Falk, the receiver, is president of the new company. Other officers are: Max W. Babb, vice-president and general attorney: L. F. Bower, secretary, and F. Woodland, treasurer. All are Milwaukee men and were officers of the former company.

Trump Manufacturing Company Not Seriously Affected by the Floods.—J. F. Trump, Jr., of the Trump Manufacturing Company, Springfield, Ohio, hydraulic engineer and manufacturer of water-power machinery, says that statements that Springfield, Ohio, and its manufacturing establishments suffered severely during the recent floods in Ohio are erroneous. "Springfield was very slightly affected," Mr. Trump states, "and her factories are operating as heretofore. With possibly one or two exceptions, none of them was obliged to close even temporarily. Aside from a short delay in receiving mail, our company experienced no embarrassment from the recent disasters. This, with slight freight delays due to the washing out of several railroad bridges outside of Springfield, since restored, was our only trouble."

New Canadian Plant for Analysis and Treatment of Feed Water.—Owing to the rapid growth of its Canadian business, the Dearborn Chemical Company, of Chicago, which specializes in the scientific analysis and treatment of boiler-feed water for railroad and stationary plant use, has organized a Canadian company with the same name to carry on its business in the Dominion. A reinforced-concrete manufacturing plant, which with its equipment, site, etc., will represent an investment of more than $100,000 when completed, is now in course of erection for the company at West Toronto. A. W. Crouch, who has been affiliated with the Dearborn company for fifteen years, and during eight of these has been district manager at Pittsburgh, in charge of a number of branch offices, is the vice-president and general manager of the Canadian company.

Says Motor Business Has Been Irregular Since First of Year.—The manager of one of the well-known motor and generator manufacturing companies in the East made the following comment this week upon electrical trade conditions: "While the last part of the year 1912 was the most prosperous season we ever experienced in our business, and our December sales, for example, were about 75 per cent above normal, business dropped off considerably in January and we did only the normal amount. Business was poor in February, falling to 25 per cent below normal. The March volume was in normal proportions, and April bids fair to be 10 per cent or 15 per cent better than March."

Cleveland Orders Equipment for Its Municipal Plant.—The city of Cleveland, Ohio, has awarded a contract to the C. H. Wheeler Manufacturing Company, of Philadelphia, Pa., for surface condensers for its new municipal plant. The initial generating equipment of the latter will consist of three 5000-kw Allis-Chalmers turbines. The Wheeler condensers which will be used in connection with these will have motor-driven Mullan patent vacuum pumps, together with motor-driven centrifugal circulating and hot-well pumps. The awarding of the contract was based to a large extent upon the performance and low-maintenance guarantees given by the condenser company.

San Joaquin Light & Power Company to Enlarge Its System.—J. G. White & Company, 43 Exchange Place, New York, have received, through their San Francisco office, a contract for doing about $1,250,000 of construction work upon the system of the San Joaquin Light & Power Company, of Fresno, Cal. The work is to be done during 1913. The improvements include additions to the company's stations and substations. An appraisal of the properties of the San Joaquin company was made by J. G. White & Company last year, as noted in these columns May 18, 1912.

Will Build Hydroelectric Plant Near Minneapolis.—Plans are being made by the Northern Mississippi River Power Company for the erection at Coon Rapids, on the Mississippi River, near Minneapolis, of a hydroelectric station which is to have an initial rating of 10,500 hp. The Northern Mississippi company, which was formed recently, is a subsidiary of the Northern States Power Company, Chicago. When the plant is completed it will be leased for a term of forty-eight years to the Minneapolis General Electric Company.

Conditions Excellent in the Transformer Business.—Discussing the transformer business, R. J. Bingay, of the Pittsburgh Transformer Company, said this week: "Business conditions are excellent with us and have been for a long time. If our orders indicate anything as to general trade conditions, we believe that there is no slacking up of general business. We have never seen such excellent conditions existing in the transformer business before. Collections are good and sales enormous."

Crocker-Wheeler Company Reports Good Business.—According to the Crocker-Wheeler Company, Ampere, N. J., demand for electrical machinery continues to be brisk and has not been affected by the prospects of downward revision of the tariff. As a result of the floods in the Middle West the company has received many rush orders.

Electrical and Mechanical Equipment of Great Northern Railway Station in Minneapolis.—Contracts have been awarded by Neiler, Rich & Company, of Chicago, engineers for Charles S. Frost, the architect, for much of the lighting, heating and power equipment for the passenger station of the Great Northern Railway Company now under construction on Hennepin Avenue, opposite High Street, in Minneapolis. A power house will be built on the premises and will contain three 300-hp Edgemoor water-tube boilers each equipped with a Foster superheater made by the Power Specialty Company. Each boiler will be fired by a Murphy automatic furnace. The coal and ash-handling machinery in the power house will be supplied by the Webster Manufacturing Company, while Henry R. Worthington has the contract for the condensing apparatus. There will be three Buckeye reciprocating engines, the largest one of the cross-compound, horizontal type and two simple engines of smaller size. Three 250-volt, direct-current generators will be driven by these engines. The largest generator will be of 250-kw rating and each of the others of 150-kw rating. All of these units will turn at 150 r.p.m. The generators and two balancer sets, as well as a number of electric motors for use throughout the power house and railway station, will be supplied by the Sprague Electric Works of General Electric Company. These motors include those operating the coal and ash-handling machinery and the fans used for the ventilating system. The contract for wiring the entire station building, which has been awarded to the Minneapolis Electric Equipment Company, includes the conduit and wiring as well as the transmission circuits from the power house to the distributing room in the basement machinery room of the station building. It also includes the distribution switchboard, telegraph and telephone conduits and fixtures other than those in the public rooms of the station. The heating and ventilating contract has been awarded to the Mehring & Hanson Company, of Chicago. This contract includes also the house pumps for the circulating of drinking water and the hot-water circulating pumps. These are Worthington pumps and are to be driven by Sprague motors. The refrigerating machine to cool the drinking water will be furnished by the Kroeschell Brothers' Ice Machine Company, of Chicago, and will be driven by a 25-hp Sprague motor. A stationary vacuum-cleaning plant will be driven by a 10-hp motor. Arrangements have been made for charging the batteries of electric baggage trucks, which are now used in several modern railway stations. R. Budd is the chief engineer of the Great Northern Railway Company and has general supervision of the erection of the new station. J. D. Mason is looking after the details of the work for Mr. Budd.

Electric Service Supplies Company Busy.—J. V. E. Titus, second vice-president of the Electric Service Supplies Company, Philadelphia, manufacturer of railway material and electrical supplies, said this week that never before in the history of the company have business conditions been as satisfactory as they have since the first of this year. "Since Jan. 1," he said, "our business has been approximately 35 per cent greater than that in the corresponding period of any previous year, and we see but few signs of slackening of activity. Our lightning-arrester business, which is our most important business with the electric-lighting field, has been particularly good this year. We booked orders up to April 1 for more than twice as many lightning arresters as have been sold by us in a like period. Our last year's business in this particular line was 42 per cent greater than in any previous year, and as a result we are having some trouble to make shipments as promptly as customers could desire. Our whole trouble, however, has been in getting materials, as our facilities are ample to take care of practically any demand. Materials are now coming in nicely. All of our manufactured lines are particularly active at the present time."

General Electric Doing a Record Business.—If the rate at which new business is being placed with the General Electric Company is maintained during the rest of the year the total business of the company in 1913 will show a large increase over that in 1912, which was the largest in the history of the company. During the three months ended March 31, 1913, incoming orders were at the rate of $129,000,000 for the year, as compared with $102,000,000 in the year ended Dec. 31, 1912. Several unusually large orders were received by the company during January and February. One of these orders called for $4,000,000 of equipment for use in Australia. Owing to the large increase in its business, the company has found it necessary to formulate plans for enlarging its manufacturing facilities. Many of the departments are now booked six to eight months ahead. These plans include the erection of a new lamp factory at East Boston, Mass., and large expansion of the facilities at Pittsfield, Mass., where the number of employees will be increased in the next two years from 6000 to 11,000. Over $1,000,000 will be expended upon new factory facilities this year at that place. The transformer business of the company is now so large that orders are being taken six months ahead of deliveries.

Westinghouse, Church, Kerr & Company's Contracts.—Among recent contracts awarded to Westinghouse, Church, Kerr & Company, 10 Bridge Street, New York, was one from the Central Railroad of New Jersey, Communipaw, N. J. This contract calls for the design and construction of a power house, 134 ft. by 92 ft., to contain equipment with a rated output of 1300 kw, steel water tanks and cooling towers, a machine shop 200 ft. by 80 ft., a storehouse 100 ft. by 60 ft., both of which are to be of brick, concrete and steel; a 90-ft., thirty-two-stall concrete roundhouse and a 100-ft., thirty-four-stall roundhouse, together with turntables, concrete coaling stations, a sand house and cinder pits. A contract placed with the same engineers by the Moore & Thompson Paper Company, Bellows Falls, Vt., calls for the installation of hydraulic equipment and a power-transmission system. For the Worcester (Mass.) Electric Light Company, Westinghouse, Church, Kerr & Company are to install a 4500-kw turbo-generator and two 700-hp boilers, together with the necessary auxiliaries.

Manufacturing Concerns Increasing Their Electrical Equipment.—Winslow & Company, of Portland, Me., have arranged to install additional equipment for electric drive in their brick plant. The new apparatus includes a 312-kva generator with a 15-kw exciter and switchboard, together with six motors ranging from 15 hp to 150 hp. All of the equipment has been ordered from the General Electric Company. The Edison Storage Battery Company, Orange, N. J., has placed an order with the same manufacturer for additional power-station equipment. This order includes two 500-kw rotary converters, two 200-kw, three-unit, four-bearing motor-generator sets, four 250-kva transformers and a quantity of switchboard apparatus. Another manufacturing concern which has made plans to place electric-drive equipment in operation is the Pittsburgh (Pa.) Screw & Bolt Company, which has ordered a 100-kw, two-unit, three-bearing motor-generator set and sixteen motors ranging from 5 hp to 50 hp from the General Electric Company.

City of Portland (Ore.) Sues for Share of Lighting Companies' Receipts.—The city of Portland, Ore., is suing the Portland Railway, Light & Power Company and the Portland Gas & Coke Company for a 3 per cent tax on gross receipts and asserts that the first-named lighting company is selling electrical energy without having a franchise. This is the second time the city has sued the companies for a share of their gross receipts. The companies are opposing the suits on the ground that the city's charter gives it no authority to impose an occupation tax.

Refinancing Plan for Northern Colorado Power Company.—In order to care for securities maturing May 1, plans are being made for a reorganization of the Northern Colorado Power Company, Denver, Col. An issue of $853,000 in notes falls due at that time, and although the company's earnings are fair, it will be necessary to arrange new financing to the amount of about $1,000,000 to meet the notes. A committee is at work on a financing plan which is to be submitted to the stockholders at a meeting on April 24.

Award Contract for Large Canadian Hydroelectric Development.—Fraser, Brace & Company, contractors, 1328 Broadway, New York, have been awarded a contract to construct a three-million-dollar hydroelectric development for the Cedar Rapids Manufacturing & Power Company, Montreal, Que.

Pacific Gas & Electric Directors and Officers Re-elected.—All directors and officers of the Pacific Gas & Electric Company were re-elected at the annual meeting and an issue of $5,000,000 6 per cent debentures was approved.

Philadelphia Electric Made a Satisfactory Showing in 1912.—The report of the Philadelphia Electric Company for the year ended Dec. 31, 1912, shows gross earnings of $7,051,497, which represents an increase of $556,740 over the receipts of the preceding year. Net income was $1,666,189, an increase of $257,458, and the surplus for the year was $691,520, which is $182,513 in excess of that for 1911. At the end of 1912 there were 45,127 consumers of electrical energy upon the books of the company, an increase of 6476 for the year. The total commercial connected load on Dec. 31, 1912, in 50-watt equivalents was 2,839,884, an increase of 359,981, as compared with that at the end of the year 1911. In addition to supplying the foregoing customers, the company is also furnishing 20,800 hp of electrical energy to street railway companies. In the *Electrical World* for April, page 711, in an item discussing the plans of the Pennsylvania Railroad to electrify its main line from Philadelphia to Paoli, it was stated that the railroad company would buy energy locally, at least for the next few years. President McCall of the Philadelphia Electric Company said last week, in reply to a question as to the probability of his company supplying the necessary energy to the Pennsylvania Railroad: "I am inclined to think the prospects are rather bright." In his report to the stockholders he said in part: "The increase in the general business is gratifying, especially when we consider the reductions made in the downtown districts and to the city by the Philadelphia company. The increased business in the territory in which the reduced rates are applicable has almost met the reductions in receipts, and we believe it will all be made up in a few months. We feel that the policy adopted in the past of voluntarily reducing rates and improving terms and conditions is a sound, practicable policy which should be continued whenever it is found possible. We made a reduction to the city in the price of street lighting for the year 1913 amounting to $42,726 on the number of lamps erected Jan. 1, 1913. During the present year, your Philadelphia company will remove one old-type engine and generator, and will install new turbo-generators which will give additional generating capacity of 30,000 kw. Plans are now being prepared for the construction of a further addition to the Christian Street Station, to include turbo-generators aggregating 50,000 kw in rated output. This latter installation should be completed by the fall of 1914 and will enable your Philadelphia company at that time to meet any increased demands for general business or the requirements of other utility or railroad companies." All the retiring directors were re-elected at the annual meeting.

Chicago Partnership Receipts from Street-Railway Operation.—By the terms of the ordinances under which the Chicago street-railway companies are operating, the city is entitled to 55 per cent of the "net divisible receipts." The amounts which have just been paid to the city, through this arrangement, for the year ended Jan. 31, 1913, were $1,413,404 from the Chicago Railways Company and $1,116,588 from the Chicago City Railway Company. The total receipts from this source were $2,529,992 for the year mentioned, and for the six years these ordinances have been in operation the payments have amounted to $10,326,391. The amount turned over by the Chicago Railways Company for the year 1912-1913 was 72 per cent more than for the preceding year, while the increase in the payment from the Chicago City Railway Company was 6.5 per cent. Under the law the city must use this money for street-railway purposes, such as creating a fund for purchasing the properties or building subways.

Interstate Public Service Company Enlarges Its Holdings.—The Interstate Public Service Company, of Indianapolis, which is the holding company for Insull properties in Indiana, has purchased the electric-lighting and street-railway systems of the Central Indiana Lighting Company, of Columbus, Ind., and is planning to acquire other properties in the same State. In accordance with plans for consolidating all of the Indiana properties controlled by it, the Interstate Public Service Company has increased its capital stock from $3,000,000 to $8,000,000.

Combine Lighting Companies in the Pittsburgh District.—The Duquesne Light Company, Pittsburgh, which is owned by the Philadelphia Company, of Pittsburgh, has taken over a number of lighting companies in Allegheny County, Pa. The merger includes the following concerns: The Pittsburgh City Light & Power Company, the Knoxville Electric Company, St. Clair Electric Company, Mount Oliver Electric Light Company, Carrick Light Company, Baldwin Township and Mount Lebanon Township Electric Light Companies.

American Cities Company's Gains.—The report of the American Cities Company, New Orleans, for the year ended Feb. 28, 1913, shows net profits of $1,785,843. This represents an increase of $174,108 over those in the preceding year. After payment of preferred dividends, there was a balance equal to 3.4 per cent on the common stock, as compared with 2.3 per cent on the same amount of stock in the preceding year. The income account shows earnings on shares owned of $2,285,843, an increase of $174,108; net earnings after charges of $1,785,843, and a balance after preferred dividends of $552,633, an increase of $174,108.

Approve Reorganization Plan for Michigan Lake Superior Power Company.—The reorganization committee for the Michigan Lake Superior Power Company, Sault Ste. Marie, Mich., has approved and adopted a plan for the reorganization of that company and has notified holders of certificates of deposit under the bondholders' agreement dated May 29, 1908, that written notice of dissent from the plan may be filed with the depositaries on or before May 12, 1913.

Havana Company Increases Its Common Dividend Rate.—The Havana Electric Railway, Light & Power Company has declared a semi-annual dividend of $2.75 a share on its common stock. This is an increase of 50 cents a share over the previous dividend. The regular semi-annual dividend of $3 a share on the preferred stock has also been declared.

Springfield (Ohio) Company to Issue Bonds.—The Ohio Public Service Commission has authorized the Springfield (Ohio) Light, Heat & Power Company to issue $350,000 general refunding bonds. The company asked permission to issue bonds to the amount of $850,000.

Tennessee Utility Property Sold.—The Watauga Power Company, of Elizabethton, Tenn., has been purchased by Henry L. Doherty & Company, 60 Wall Street, New York

Industrial Securities

Security	Capital Stock Listed	DIVIDEND		QUOTATION	
		Per Cent	Period	April 9	April 16
Allis-Chalmers, t.r., 3d pd...	$15,501,800	.....	.....	3½	3
Allis-Chal., pf., t.r., 3d pd...	14,115,500	.....	.....	8½	6⅞
Amalgamated Copper.....	153,887,900	1½	Q	78	76½
American Tel. & Tel.....	344,461,300	2	Q	131¾	131¼
Electric Storage Battery, c.	16,074,425	1	Q	50½	50
General Electric.....	101,300,600	2	Q	141	139⅞
Mackay Cos., c.....	41,380,400	1¼	Q	83*	83*
Mackay Cos., pf.....	50,000,000	1	Q	68¼*	69*
Western Union Tel.....	99,747,200	¾	Q	69¼	66½
Westinghouse, E. & M., c...	34,048,600	1	Q	65¾	63¼
Westinghouse, E. & M., pf..	3,998,700	1¾	Q	117*	116¾*

*Last price quoted.

NEW YORK METAL MARKET PRICES.

	April 8 Bid.	April 8 Asked.	April 15 Bid.	April 15 Asked.
Copper:				
Standard, spot	14.75	to 15.25	15.12½	to 15.50
	£ s d		£ s d	
London, standard, spot	68 5 0		69 1 3	
Prime Lake	15.45	to 15.55	15.60	to 15.70
Electrolytic	15.35	to 15.45	15.55	to 15.65
Casting	15.20	to 15.30	15.40	to 15.50
Copper wire, base	16.25	to 16.50		16.50
Lead		4.35		4.35
Nickel	40.00	to 45.00	40.00	to 45.00
Sheet, zinc, f.o.b. smelter		8.00		8.00
Spelter, spot	5.90	to 6.00	5.75	to 5.87½
Tin, spot		48.00		49.40
Aluminum:				
Prompt delivery	26.75	to 27.50	26.75	to 27.00
Future	26.75	to 27.50	26.75	to 27.00

OLD METALS.

Heavy copper and wire	14.50	14.75
Brass, heavy	9.37½	9.37½
Brass, light	8.25	8.25
Lead, heavy	4.25	4.25
Zinc, scrap	5.12½	4.87½

COPPER EXPORTS IN APRIL.

Total tons to April 16 15,976

Personal

Dr. Albert C. Crehore will sail from New York on April 26 to spend about two months in England.

Mr. Fred B. Philbrick is the new manager and contract agent of the New Market (N. H.) Electric Company.

Mr. E. S. Jefferies has been appointed electrical engineer of the Steel Company of Canada, Ltd., Hamilton, Ont.

Mr. Alex. Speer has recently been appointed general superintendent of the McCook (Neb.) Electric Company.

Mr. E. Lowndes Rhett has been elected second vice-president and a director of the Federal Utilities, Inc., New York.

Mr. L. E. Best has succeeded Mr. H. R. Holdeman as manager of the O'Neill Light & Power Company, O'Neill, Neb.

Mr. George M. Mills has been appointed district manager of the Goldfield plant of the Nevada California Power Company.

Mr. Harry T. McDevitt has been appointed treasurer and manager of the Ocean City Electric Light Company, Ocean City, N. J.

Mr. H. H. Johnson has succeeded Mr. B. C. Robinson as general manager of the municipal electric lighting plant at Clarkson, Neb.

Mr. M. J. Howe has succeeded Mr. E. V. Lombard as superintendent of the municipal electric-lighting plant at Lake City, Minn.

Mr. G. G. Sawyer has been appointed manager and Mr. E. N. Bonden superintendent of the new electric-lighting plant at Annandale, Minn.

Mr. Jacob B. Walter, after five years' superintendency of the municipal electric-light plant at Augusta, Ky., has retired from active business.

Mr. Henry H. Berg has recently been appointed to the new office of superintendent of the municipal lighting and water plant at Orange, N. J.

Mr. W. H. Johnson, first vice-president of the Philadelphia Electric Company, has been elected a member of the board of directors of that company.

Mr. John T. Brady, treasurer of the Denver Gas & Electric Light Company, Denver, Col., is confined to his room by a severe nervous breakdown due to overwork.

Mr. A. G. Sangster, formerly electrical superintendent at Saskatoon, Sask., has opened an office in that city as consulting engineer on electrical and hydraulic work.

Mr. Paul Pracht has succeeded Mr. W. A. Hill as manager of the municipal electric-lighting plant at South Stillwater, Minn., adding the duties of superintendent.

Mr. R. J. Smith, formerly with J. G. White & Company, Inc., New York City, has been appointed chief engineer of the Tri-City Railway & Light Company, Davenport, Ia.

Mr. W. S. Dickerson has assumed the management of the power development for the Big Falls Manufacturing Company, Big Falls, Minn., which is now under construction.

Mr. David Riepe is the new manager and superintendent of the municipal water and lighting plant at Higginsville, Mo., a position previously occupied by Mr. Frank Monser.

Mr. Kenneth Myers now combines the duties of secretary, treasurer and manager for the Gallup (N. M.) Electric Light Company, having succeeded Mr. George W. Burgess.

Mr. William Marconi has been presented with the Grand Cross of the Order of the Crown of Italy for his work in organizing the wireless system in the Italian-Turkish war.

Mr. Howard L. Reichart was on April 2 appointed assistant secretary of the Rochester Railway & Light Company, with headquarters in the Grand Central Terminal, New York City.

Mr. Otto Snyder has been appointed assistant superintendent of the Houghton County Electric Light Company of Houghton, Mich., and will assume charge of the Houghton division.

Mr. John H. Smith has resigned his position as commercial engineer of The Milwaukee (Wis.) Electric Railway & Light Company to engage in consulting engineering work in Milwaukee.

Mr. T. C. O'Hearn, city electrician of Cambridge, Mass., was presented with a gold badge on April 7 by friends in the local department, in recognition of his ten years' service at Cambridge.

Mr. H. E. Sherman has joined the San Francisco sales force of the Crocker-Wheeler Company, having recently resigned his position with the Great Western Power Company at Oakland.

Mr. W. H. Tees has resigned as chief electrician of the Canadian Consolidated Rubber Company, Montreal, Que., and is now assistant superintendent of the Sayer Electric Company of Montreal.

Mr. Elmer Iverslin has succeeded Mr. P. B. Renther as chief engineer of the municipal electric-lighting plant at Belgrade, Minn., and has in addition taken on the duties of manager and superintendent.

Mr. H. H. Chilson has become superintendent of the municipal electric-lighting plant at Buffalo, Minn., succeeding Mr. A. E. Anderson in that office. Mr. Anderson remains as engineer of the plant.

Mr. W. A. Layman, of the Wagner Electric Manufacturing Company, St. Louis, Mo., was elected president of the National Metal Trades Association at its fifteenth annual convention held in New York, April 9.

Mr. C. E. McFarland, formerly vice-president and general manager of the Nebraska Telephone Company, has become associated with the Pacific Telephone & Telegraph Company, succeeding Mr. C. C. Bradley, resigned.

Mr. Carl A. Lohr, electrical engineer of the New York office of the Siemens-Halske A. G. and Siemens-Schuckertwerke G. m. b. H., has been transferred to the patent department of the company in Berlin, Germany.

Mr. M. J. Shugrue, recently appointed assistant engineer of the engineering department of the Edison Electric Illuminating Company of Brooklyn, was formerly chief engineering draftsman for the company. His successor in this position will be Mr. E. B. Rannells.

Mr. Herbert C. Porter, for two years commercial agent for the Montgomery (Ala.) Light & Water Power Company, was the guest at a fareweil dinner tendered by Montgomery friends upon his removal to St. Joseph, Mo., to take up new work with the Doherty interests.

Mr. Oscar Sorenson is superintendent of the Citizens' Light, Heat & Power Company, of Canby, Minn. Through an error Mr. Sorenson's location was recently given in this column as Cass Lake, Minn. For the company at that place Mr. Heber L. Hartley is secretary, treasurer and manager.

Mr. William Kruse has been appointed general manager of the Northumberland County Gas, Light & Power Company, of Sunbury, Pa., whose system serves seven cities and towns in the Susquehanna River Valley. Mr. Kruse was formerly superintendent of Public Works at Vineland, N. J.

Mr. R. W. Hemphill, Jr., manager of the Washtenaw division of the Eastern Michigan Edison Company, which serves Ann Arbor, Ypsilanti and other nearby towns, is a candidate for member of the Michigan Board of Agriculture. Mr. Hemphill is a past-president of the Michigan Section of the National Electric Light Association.

Mr. William E. Hodge has been appointed deputy superintendent of street lighting, Springfield, Mass. Mr. Hodge is a graduate of the Massachusetts Institute of Technology and has worked for the Westinghouse Electric & Manufacturing Company, the Boston Elevated Railway Company and the New England Telegraph & Telephone Company.

Mr. M. H. Bennett, chairman of the Brooklyn Company Section of the N. E. L. A., and assistant superintendent of the meter department of the Edison Electric Illuminating Company of Brooklyn, has severed his connection with the latter company and accepted the position of research engineer of the Scovill Manufacturing Company, Waterbury, Conn.

Mr. F. W. Humphreys has resigned as general manager of the Pontiac Power Company, of Pontiac, Mich., after having been in charge of these local plants for the past fourteen months. He leaves to do consulting work for various corporations in Eastern Michigan, and, although

continuing to reside in Pontiac, will open an office in Detroit.

Mr. Charles L. Clarke, who was one of Edison's earliest associates in the introduction of the direct-current system and who has been more recently connected with the legal bureau in New York, has been appointed consulting engineer to the General Electric Company as associate with Dr. Steinmetz. Mr. Clarke will make his headquarters at Schenectady.

Mr. J. A. Patten, who has been appointed engineer for the La Crosse (Wis.) Gas & Electric Company, was formerly engineer and manager for the Winona (Minn.) Gas Light & Coke Company. He has also been stationed at Saginaw, Mich., Manitowoc, Wis., Holland, Mich., and Salt Lake City, Utah. The La Crosse company is planning to rebuild both its electric and gas plants.

Prof. Henry H. Norris, of the department of electrical engineering, Cornell University, and secretary of the Society for the Promotion of Engineering Education, is devoting a leave of absence to a special investigation of engineering books in all fields for the McGraw-Hill Book Company, New York. His work will cover both college textbooks and general technical reference books.

Mr. Frank G. Bolles, at one time commercial engineer of the Allis-Chalmers Company and later with the Reliance Engineering & Equipment Company, has been appointed by the Department of Commerce as commercial agent to investigate trade conditions abroad. Mr. Bolles, who was at one time secretary of the Manufacturers' Association of Racine, Wis., has made a special study of trade conditions and has made other trips abroad upon similar missions. Mr. Bolles will probably be absent in Europe for a number of months.

Mr. E. H. McHenry has resigned as vice-president of the New York, New Haven & Hartford Railroad and as vice-president of the Connecticut Company and other affiliated companies. He has had charge of engineering, maintenance and construction work of the New York, New Haven & Hartford Railroad, including the original electrification work between New York and Stamford and the extension of the electric zone from Stamford to New Haven, which work is now under way. Mr. McHenry's resignation takes effect on May 1.

Mr. Frederic W. Hild, general manager of the Portland (Ore.) Railway, Light & Power Company, has been elected president of the Pacific Coast Electric Railway Association, which was organized at San Francisco, Cal., April 1, 1913. Mr. Hild, who was educated at Union College, Schenectady, was for a time connected with the General Electric Company and was afterward assistant general manager and chief engineer of the Havana (Cuba) Electric Railway. While with the General Electric Company Mr. Hild assisted in the rehabilitation work carried out by the Twin City Rapid Transit Company, the Kansas City Railway & Light Company and the Chicago Edison Company.

Mr. E. C. Deal, general manager of the Augusta-Aiken Railway & Electric Company, Augusta, Ga., has been elected a vice-president of the company. Mr. Deal, who is a native of Atlanta, obtained his early experience in the utility field with the Georgia Electric Light Company, now the Georgia Railway & Power Company. He subsequently became connected with properties in Baltimore, Seattle, Brockton and Terre Haute, and previous to becoming connected with the Augusta-Aiken Railway & Electric Company was manager of the North Carolina Public Service Company at Greensboro, N. C. For a time Mr. Deal was also chief engineer of the Gas & Electric Company of Bergen County, N. J.

Mr. E. D. Alexander has been appointed assistant to the president of the Illinois Northern Utilities Company, with headquarters in Dixon, Ill. Mr. Alexander will have charge of the actual operation of the company, which controls a large number of electrical utilities in northwestern Illinois. He is an experienced and capable electric-service manager, and for a number of years was vice-president and manager of the old Englewood Electric Light Company, of Chicago. Mr. Alexander subsequently became connected with the Insull group of electrical utilities, having for some time served with the North Shore Electric Company, and also with the Illinois Northern Utilities Company, of which he is now put in active charge.

Obituary

Rogers V. Scudder, vice-president and general manager of the Wesco Supply Company of St. Louis and for a number of years well known in business circles in that city, committed suicide at his suburban home in Kirkwood on April 13. It is surmised that business worries caused a mental breakdown, which must be looked upon as the explanation for the impulse that led the unfortunate man to take his own life. Mr. Scudder was forty-four years old. He leaves a widow and two children. He was a member of the Illuminating Engineering Society, the Jovian Order, the St. Louis League of Electrical Interests and other electrical societies. He also belonged to the St. Louis Club and was one of the directors of the Society for Electrical Development.

ROGERS V. SCUDDER

Francis B. Badt, who died on April 12 after a protracted illness, was one of the prominent figures in electrical engineering and business circles in Chicago, although his activities had been curtailed of late by impaired health. He was born in St. Petersburg, Russia, Oct. 4, 1849. He spent a large portion of his early life in Germany, however, and was graduated from the Royal Gymnasium of Prussia. He joined the artillery corps of the Prussian army in 1868 and two years later was graduated from the Government Military Academy. He served through the Franco-Prussian war and at its conclusion attended the school for officers of artillery and engineers. Graduating from the Imperial Technical High School in 1872, he was commissioned lieutenant of artillery in the German army, serving under the Minister of War until his removal to the United States in 1881. For services during the Franco-Prussian war he received the decoration of the Iron Cross, of which he was justly proud, and also the campaign medal of the German army. From 1881 to 1888 Lieutenant Badt was superintendent of the construction department of the old United States Electric Light Company of New York. In the year last mentioned he moved to Chicago and became connected with the Western Electric Company. The following year he was made district engineer in Chicago of the United Edison Manufacturing Company. In 1890 he went with the Thomson-Houston Electric Company and was made manager of the power and mining department of the Chicago office. This connection lasted until the Thomson-Houston Company was merged into the General Electric Company in 1892. From 1894 to 1897 Mr. Badt was general manager of the Siemens & Halske Electric Company of America. He then organized the firm of F. B. Badt & Company, which was succeeded about two years ago by the Badt-Westburg Electric Company, of which the decedent was president. This company is the Western selling agent for the Weston Electrical Instrument Company and the Ward-Leonard Electric Company. Mr. Badt was a man of ability and force and had an unusually wide acquaintance. He was a member of the American Institute of Electrical Engineers, the Western Society of Engineers and the Electric Club of Chicago as well as the Union League Club of Chicago and the Midlothian Country Club. In former years he did considerable writing for the technical press and was the author of several handbooks.

FRANCIS B. BADT

Construction

New England

GONIC, N. H.—The Gonic Mfg. Co. will soon begin work on the construction of a 1000-ft. canal in connection with the installation of a power house in Gonic.

SALEM, N. H.—A bill has been introduced to the State Legislature asking permission to incorporate a company to be known as the Salem El. Lt. Co. for the purpose of generating and distributing eletricity for lamps, heaters and motors in the towns of Salem, Hampstead, Island Pond, Windham and Atkinson, and if necessary to erect transmission lines across the town of Derry for the purpose of supplying electricity to said towns. The incorporators are: Frank P. Woodbury, Ernest R. Woodbury and Fred C. Buxton, of Salem.

WARREN, N. H.—The Warren Wtr. & Lt. Co. is contemplating extending its electric-lighting service to Wentworth, provided that sufficient patronage can be secured. Edgar S. Carbee is treasurer and manager.

BENNINGTON, VT.—Sealed proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until May 15 for installing electric conduits, wiring and interior lighting fixtures for the United States post office building at Bennington, Vt., in accordance with plans and specifications, which may be obtained from the above office or from custodian of site. O. Wenderoth is supervising architect.

AGAWAM, MASS.—The Amherst Pwr. Co. has purchased the property of the Agawam El. Co. from the Northern Connecticut Lt. & Pwr. Co. The Amherst proposes to build a large substation here as soon as the transmission lines to Feeding Hills, now under construction, are completed. The initial installation of the substation will provide for 5000 kw, with provisions to increase it to 20,000 kw. George W. Lawrence is general manager and F. L. Hunt chief engineer, both of Greenfield.

CONCORD, MASS.—At the annual town meeting held April 7 it was voted to issue bonds not to exceed $15,000 to purchase and install a new 500-kva turbo-generator and condenser in the municipal electric-light plant. The turbo-generator will replace the following engine unit, which will be sold: one 125-hp, 9-in. by 17-in. by 12-in. tandem compound piston-valve Harrisburg engine directly connected to a 75-kw, 2200-volt, 60-cycle, two-phase, 300 r.p.m. Westinghouse revolving-armature generator. The engine is fitted with a speed-changing device for synchronizing the generator and adjusting the load. For further information address A. W. Lee, of Concord, manager.

LENOX, MASS.—At a town meeting held recently the citizens voted to abolish the present oil lamps and to contract with the Lenox El. Co. to install electric lamps on the main thoroughfares. The contract is for a period of 20 years and provides for 75 lamps of 32 cp, at $35 each per year. The lamps will be maintained by underground wires.

MIDDLEBORO, MASS.—At a recent town meeting it was voted not to sell the municipal electric-light plant and to discharge the committee appointed to negotiate with the Edison El. Co. of Brockton in reference to purchasing the municipal plant.

SPRINGFIELD, MASS.—Plans are being considered by the city for the installation of an electric-light plant to furnish electricity for lighting the group of municipal buildings recently completed.

SPRINGFIELD, MASS.—The Amherst Pwr. Co. has applied to the State Harbor and Land Commission for permission to erect wires across the Connecticut River from West Springfield to Springfield. The plans filed with the commissioners provide for the erection of a 66,000-volt transmission line across the Agawam meadows directly across the river to the State Street station of the United El. Lt. Co. E. L. Clark is local representative of the company.

TURNERS FALLS, MASS.—The prudential committee of the Turners Falls fire district is contemplating substituting smaller lamps for the street arc lamps now in use. The five-year contract with the Franklin El. Lt. Co. for lighting the streets will soon expire.

WALES, MASS.—The town of Wales has voted to light the streets with electricity and has appropriated $500 for that purpose.

WORCESTER, MASS.—Sealed bids will be received by the trustees of the Worcester State Asylum until May 5 for the construction of a number of buildings at the Grafton Colony. The general construction, plumbing, heating and electric wiring will be considered as separate contracts. Plans and specifications may be seen at the office of the Fuller & Delano Co., architects, 44 Front Street, Worcester.

Middle Atlantic

BREWERTON, N. Y.—Fred J. Auburn, owner of the Cicero electric plant, has applied to the Public Service Commission, Second District, for permission to extend his transmission lines from Cicero to Brewerton, a distance of 2 miles, to supply electricity for street-lighting and commercial purposes.

BROOKLYN, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Department of Education, corner of Park Avenue and Fifty-ninth Street, New York, N. Y., until April 28, for installing electrical equipment in new Public School 99, located on East Ninth and East Tenth Streets, borough of Brooklyn. Blank forms, plans and specifications may be obtained or seen at the office of the superintendent and also at the branch office, 131 Livingston Street, borough of Brooklyn.

BUFFALO, N. Y.—Bids will be received until April 30 by the State Hospital Commission, Capitol, Albany, for construction of tuberculosis pavilion, including heating, plumbing and electric work; addition to bakery, construction and plumbing work; remodeling cold-storage building, construction and electric work, at the Buffalo State Hospital, Buffalo, N. Y. Plans and specifications may be seen and blank forms of proposals obtained at the Buffalo State Hospital, Buffalo, and at the office of Charles A. Sussdorff, state architect, Capitol, Albany. T. E. McGarr is secretary of commission.

CORNING, N. Y.—The Corning Lt. & Pwr. Co., recently incorporated with a capital stock of $500,000, will take over the property of the Corning Gas & El. Co. The reorganized company will erect a large power plant this summer of sufficient output to meet the growing demands in both Corning and Painted Post. The present power plant is leased from the Corning & Painted Post St. Ry. Co.

HUDSON, N. Y.—A new street-lighting system will be installed in Hudson to be ready for use on Sept. 12. The plans call for 850 new lamps of about 60 cp. About 115 ornamental standards will be erected on Seventh Street; each standard will carry two lamps; 15 standards, carrying three lamps each, will be erected in Franklin Park, Promenade Hill and Public Square. The remainder of the lamps will be erected on the present poles. The Albany Southern R. R. Co. furnishes the street lighting service.

MALONE, N. Y.—Preparations are being made for the construction of a hydroelectric power development at Chasm Falls during the coming summer. The work will include the construction of concrete dam, power house and penstock, which will be 3000 ft. long and 7 ft. in diameter. The plant when completed will furnish electricity for operating the mills of the Malone Paper Co. C. E. Eaton, of Watertown, will have charge of the engineering work. M. S. Wilder, of Watertown, and B. R. Clark, are principal owners and promoters of the project.

NEW YORK, N. Y.—The Bronx Gas & El. Co. has applied to the Public Service Commission for permission to issue $200,000 in bonds, the proceeds to be used for the acquisition of property and improvements to its plant.

ROCHESTER, N. Y.—The lamps and electricity committee of the Common Council has passed favorably upon ordinances for installing inverted magnetite-arc lamps on Elm Street from Chestnut to Main Street, Clinton Avenue south from Main to Monroe Street, and South Avenue from Main to Court Street. Petitions have been received from several streets for Mazda lamps.

SYRACUSE, N. Y.—The Common Council has approved the proposition to issue $65,000 in bonds for the completion of the fire-alarm system.

SYRACUSE, N. Y.—The Public Service Commission has authorized the Syracuse Ltg. Co. to issue $239,000 in bonds, the proceeds to be used for extensions and improvements to its plant in Syracuse.

SYRACUSE, N. Y.—Bids will be received at the office of the Board of Contract and Supply of the city of Syracuse until April 28 for furnishing materials and constructing the addition to the Bellevue Heights School, including wiring, plumbing, heating and ventilating, in accordance with plans and specifications on file in the office of Board of Control. Bids will also be received until May 5 for furnishing material and construction of the new Genesee School Building, including wiring, plumbing, heating and ventilating, in accordance with plans and specifications on file in the office of the Board of Contract and Supply. John J. Halloran is secretary pro tem.

ALTOONA, PA.—Preparations are being made by the Penn Central Lt. & Pwr. Co., of Altoona, for the construction of a new steam-driven power plant. The initial installation will provide for 2100 kw. The site of the plant has not yet been decided upon, but it will be located in the heart of the coal district. The company is also extending its transmission lines through all parts of northern Cambria County. E. B. Greene is general manager.

DAUPHIN, PA.—The Harrisburg Lt. & Pwr. Co. has applied to the Borough Council for a franchise to erect transmission lines throughout the entire municipality to supply electricity for lamps and motors.

HAUTO, PA.—The power plant of the Lehigh Coal & Navigation Co., at Hauto, is nearing completion. The plant will supply electricity within a radius of 30 miles of Hauto. The initial installation will provide for 30,000 kw, which will be increased to 110,000 kw.

LATROBE, PA.—The Latrobe Steel Co., recently incorporated, will build a plant near the works of the Vanadium Alloys Steel Co. for the manufacture of manganese steel casting by the electric process. The company will install five 10-ton furnaces and will secure energy from the West Penn Trac. Co. Complete foundry equipment will be purchased and a large steel hammer will be installed. Marcus Saxman, of the Latrobe-Connersville Coal Co., is president of the company.

NEW CASTLE, PA.—At a special election to be held June 3 the proposition to issue $200,000 in bonds for the installation of a municipal electric-light plant will be submitted to the voters.

PHILADELPHIA, PA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until May 5, for a freight elevator in the United States post office and court house in Philadelphia, Pa., in accordance with specifications, copies of which may be had at the above office or at the office of the custodian. O. Wenderoth is supervising architect.

PHILADELPHIA, PA.—Proposals will be received until May 5 at the office of the supervising architect, Treasury Department, Washington, D. C., for an electric freight elevator in the United States post office and court house, Philadelphia, Pa., in accordance with plans and specifications, copies of which may be had at the above office, or at the office of the custodian, Philadelphia. O. Wenderoth is supervising architect.

SAYRE, PA.—The Borough Council has closed a contract with the Sayre El. Co. for street lighting for a period of five years. The new contract calls for five 80-watt lamps at $23 each per year and 190 60-watt lamps at $22 each per year. The borough reserves the right to install arc lamps at $68 each per year if desired. Under the present contract the company furnishes 196 lamps of 30 cp at $20 per lamp per year.

SCRANTON, PA.—The Scranton El. Co. is negotiating with the Scranton & Binghamton Trac. Co. to furnish electricity for operating its electric railway. The Scranton El. Co. has closed a contract with the Scranton Ry. Co. to take effect Oct. 1, 1913, whereby it will furnish energy to operate the system of the Scranton Ry. Co. for a period of 20 years. The electric company is preparing to make extensive changes at its North Washington Avenue plant, near Linden Bridge. Duncan T. Campbell is general manager of the Scranton El. Co.

CAMDEN, N. J.—Bids will be received at the office of the city clerk, City Hall, Camden, N. J., directed to the chairman of the municipal electric light plant committee, until June 16, for the installation of a municipal electric-light plant in accordance with plans and specifications, copies of which may be seen at the office of Runyan & Cary, 122 Market Street, Newark, N. J. Bids will be received for the following work: (1) For power station, including excavation, concrete piling, foundations, building chimney, coal-handling equipment and crane; (2) boiler and generating equipment, including boilers, stokers, breeching, forced-draft blower, pumps, turbo-generators, exciters, condensing apparatus with all steam, water and air piping; (3) electric work, including switchboard, arc-lighting apparatus, feeder regulators, station wiring and outside distributing system. Proposals will be received for the several items as above enumerated, for any two of the items or for the entire installation. Frederick A. Finkeldey is chairman of the committee.

CAPE MAY COURT HOUSE, N. J.—The Stone Harbor El. Lt. & Pwr. Co., of Stone Harbor, is planning to erect a power plant in Cape May Court House for the purpose of furnishing electricity for lamps and motors in that place, Avalon and Stone Harbor. When the new power house is completed the present plant at Stone Harbor will be used as an auxiliary station.

MANASQUAN, N. J.—Councilman James Moore, who was appointed to investigate the matter of establishing a municipal electric-light plant, has submitted his report to the Council, in which he recommends the installation of a municipal plant.

TERRA ALTA, W. VA.—The local electric-light plant, owned by J. Arni Martin, has been purchased by William F. Patterson, of Waynesburg, Pa.

ROANOKE, VA.—Arrangements are being made by the Norfolk & Western Ry. Co. to equip its railway from Eckman to Bluefield, a distance of 27 miles, for electrical operation. Negotiations are under way with the Appalachian Pwr. Co. to furnish electricity to operate the road. Preliminary work is now under way. L. E. Johnson, of Roanoke, is president.

WINCHESTER, VA.—Final surveys are being made in Berkeley and Jefferson Counties in West Virginia and in Frederick and Clarke Counties in Virginia for the proposed electric railway of the Shenandoah Valley R. R. Co., which will make direct connection with the Washington-Bluemont branch of the Washington & Old Dominion Ry. Co., at Bluemont. Clarence W. Watson, of Fairmont, W. Va., is interested in the company.

WASHINGTON, D. C.—Bids will be received at the office of the chief signal officer, War Department, Washington, D. C., until April 24, for furnishing the Signal Corps with 528,000 ft. outside distribution wire, as per specifications 557. Further information may be obtained upon application to Major W. L. Clark, disbursing officer. The date for receiving these bids was given as April 21 in the issue of April 12.

North Central

BIG RAPIDS, MICH.—The Big Rapids El. Co. is planning to rebuild its dam recently carried away. E. C. Newcombe, of Big Rapids, is president.

MOUNT CLEMENS, MICH.—The business men have offered to pay for the installation of an ornamental street-lighting system, provided the city will agree to pay for electricity to maintain the lamps.

SAGINAW, MICH.—Mayor Tausend has recommended the installation of fifty additional mast-arm lamps during the coming year to be erected in the outlying districts.

CLEVELAND, OHIO.—The County Commissioners have abandoned the plan to build a lighting plant for the new court house. A contract has been made with the Cleveland El. Illg. Co. to furnish electricity to light the new court house for a period of ten years.

CUSTAR, OHIO.—Arrangements are being made for the installation of an electric distributing system in Custar, for which bonds have been sold. Electricity for operating the system will be purchased from the Ohio El. Ry. Co., of Lima.

LINDSEY, OHIO.—The contract for the installation of an electric-light system in Lindsey has been awarded to the Whipple Strub Co., of Toledo. W. W. Woodruff is clerk.

PAULDING, OHIO.—Sealed proposals will be received until April 29 for prime movers, boilers, generators, switchboard, transformers, meters, tank and tower, pumps, poles, etc., for the light and water station at Paulding, in accordance with plans and specifications on file in the office of the Board of Trustees of Public Affairs. Copies of specifications may be obtained from the Capitol Engineering Co., Union National Bank Building, Columbus, engineers. J. F. Morisey is president of the board.

PIQUA, OHIO.—The City Council has accepted the proposition of the Franklin El. Co. to install ten ornamental lamps along the Liberty Street side of the parks, thus completing the ornamental lighting system on Liberty Street to the Galum Signal Building.

SPRINGFIELD, OHIO.—The substation of the Springfield, Troy & Piqua Ry. Co. was recently destroyed by an explosion, causing a loss of about $10,000.

STEWARTSVILLE, OHIO.—The power plant of the Franklin Coal Co., at Stewartsville, was recently destroyed by fire, causing a loss of about $18,000. Two dynamos, one 200-kw and the other 125-kw, two boilers and two engines were either destroyed or badly damaged.

WARREN, OHIO.—The Electric Realty Co. is erecting a building at the corner of High Street and Park Avenue. The building will be known as the Electric Building. R. B. Wick is president of the company.

WILMINGTON, OHIO.—The Wilmington Wtr. & Lt. Co. expects to purchase within the next two months three series alternating-current rectifying switchboards for street-lighting outfits, two 50-lamp circuits and one 25-lamp circuit; also 110 4-amp, 2200-volt metallic arc lamps for street lighting with rectifying outfit complete. George M. West is manager.

BLOOMFIELD, KY.—The city of Bloomfield has entered into a contract was Harry M. Logan for street-lighting for a period of ten years. Mr. Logan will also furnish electricity for commercial lighting and motors. A day service will be established. It is expected to have the plant ready to put in operation by May 1.

ELIZABETHTOWN, KY.—The Kentucky Utilities Co., of Lexington, which has purchased the property of the Elizabethtown El. Lt. Co., has applied to the City Council for extension to franchises. The company proposes establishing a day service and furnishing electricity to manufacturing plants and to operate the pumping station of the city water-works.

COLUMBUS, IND.—The property of the Central Indiana Ltg. Co., of Columbus, has been purchased by the Interstate Pub. Ser. Co., of Indianapolis. The company has been reorganized with Chester P. Wilson, vice-president of the Interstate company, as president; Howard L. Olds, vice-president, and Ira Guthrie, secretary and treasurer.

INDIANAPOLIS, IND.—The capital stock of the Interstate Public Ser. Co. has been increased from $3,000,000 to $8,000,000. It is expected that the company will consolidate the various properties owned by it in Indiana in the near future.

NATIONAL MILITARY HOME, IND.—Bids will be received at the office of the treasurer of the Marion branch of the National Home for the Disabled Volunteer Soldiers, National Military Home, Grant County, Ind., until May 2, for furnishing and installing steam boiler, etc., and enlarging power house in accordance with specifications, copies of which may be obtained upon application to J. W. Sanderson, treasurer.

ALTON, ILL.—The city of Alton is contemplating the construction of a municipal light and power plant. J. E. Schwaab is city engineer.

ALTON, ILL.—Roy Holden, manager of the Piasa Lt. & Pwr. Co., has announced that his company will not erect a power plant in Alton but will secure power from the Mississippi River Pwr. Co., of Keokuk, and will erect a substation in Alton.

BRADFORD, ILL.—The Stark County Pwr. Co., of Wyoming, which recently purchased the local electric plant, has applied to the Village Council for a 20-year franchise to furnish electricity in Bradford. The company also seeks a five-year contract for lighting the streets of the village and for operating the pumping station of the municipal water-works system. Electricity will be transmitted to Bradford from the plant in Wyoming.

DE KALB, ILL.—Application has been made to the City Council by the Jacob Haish Co. for a franchise to install and operate an electrical distributing system to supply electricity for commercial and private uses in De Kalb.

GALESBURG, ILL.—The Central Union Tel. Co. has announced that it will rebuild its telephone lines between Galesburg and Quincy, at a cost of about $50,000.

HILLSBORO, ILL.—The Hillsboro Lt. & Pwr. Co., it is reported, is purchasing the right-of-way for its proposed line to run from Hillsboro to Pana.

HILLSBORO, ILL.—The City Council has appointed a committee, consisting of H. S. Hargrave and E. T. McDavid, to take up with the Montgomery County Board of Supervisors the matter of installing ornamental lamps about the court house square. The City Council has an-

nounced that it expects the business men and property owners to take up the question of ornamental lighting, as it wishes to change the entire street-lighting system of Hillsboro.

JACKSONVILLE, ILL.—The County Commissioners are reported to be considering the question of issuing bonds to the amount of $50,000 for the installation of a lighting plant.

KENNEY, ILL.—Application has been made to the Village Board by West & Veail, of Mount Pulaski, for a franchise to furnish electricity for lamps and motors in Kenney. If granted a franchise, a transmission line will be erected from the plant at Mount Pulaski to Kenney.

MOLINE, ILL.—The People's Pwr. Co. has increased its capital stock from $2,000,000 to $4,000,000.

MONMOUTH, ILL.—Walsh Brothers, who operate the Rock Island Southern R. R. Co. running between Rock Island and Galesburg, have applied to the City Council for a franchise to furnish electricity for lamps and motors in Monmouth for a period of 30 years.

MOUNT PULASKI, ILL.—The Mount Pulaski El. Lt. & Pwr. Co. will enlarge its power plant to provide for a day service for lamps and motors. New equipment will be installed, including one 100-hp boiler, one Bates Corliss engine, two belted generators, switchboard and new transformers. The generators, switchboard and transformers have not yet been purchased. The company will also purchase wire and poles for 20 miles of pole line and 75 meters. Two substations will also be erected. West & Veail are owners.

PEORIA, ILL.—The City Council is considering an ordinance extending the underground conduit system on South Adams Street from Oak Street to Cedar Street, also one block on Lincoln Street.

ROCK ISLAND, ILL.—Commissioner Reynolds contemplates making a change in the lamps for lighting the alleys. At present arc lamps are used.

SPRINGFIELD, ILL.—Sealed proposals will be received by John S. Shnepp, Mayor, until April 28 for improvement to the municipal electric-light plant, according to specifications now on file in the office of Willis J. Spaulding, commissioner of public property, and in the office of Arthur M. Morgan, Harris Trust Building, Chicago, Ill., consulting engineer, where copies of specifications may be obtained.

DEER PARK, WIS.—The village of Deer Park is contemplating the installation of an electric-light plant.

DELAVAN, WIS.—The City Council, it is reported, has decided to install 25 ornamental street lamps.

MADISON, WIS.—The State Street Improvement Association is considering the installation of ornamental lamps on State Street. F. W. Huels is secretary.

MADISON, WIS.—Bids will be received by the secretary of the special building committee of the State Historical Society of Wisconsin, Madison, Wis., until April 28, for furnishing one electric elevator for the northwest wing of the State Historical Library Building in Madison. Plans and specifications may be obtained upon application to secretary.

MILWAUKEE, WIS.—The Milwaukee El. Lt. & Ry. Co. has submitted propositions to Fort Atkinson, Johnson Creek and Jefferson to furnish electricity in those towns from its power plant at Kilbourn, via Watertown.

CROSBY, MINN.—Plans are being considered for the installation of an ornamental street-lighting system in Crosby. It is proposed to install from 30 to 40 ornamental lamp standards, carrying five-lamp clusters. For further information address the secretary of the Commercial Club.

EAST GRAND FORKS, MINN.—The contract for construction of building for substation has been awarded to Kennedy & McCoy, of Fargo, N. D. The station when completed will be equipped with switchboard, etc., for distribution of electricity generated by the municipal electric plant.

MINNEAPOLIS, MINN.—A new company has been organized under the name of the Northern Mississippi River Pwr. Co. to construct and operate a hydroelectric power plant at Coon Rapids, on the Mississippi River, near Minneapolis. The plant, when completed, will develop 15,000 hp, and it will be leased to the Minneapolis General Electric Co. for a term of 48 years. The company is a subsidiary of the Northern States Pwr. Co., of Chicago, Ill.

OWATONNA, MINN.—Preparations are being made for the installation of an ornamental street-lighting system, for which $10,000 in bonds have been issued.

ST. CLOUD, MINN.—The Public Ser. Co. is making arrangements to install luminous arc lamps in the business section of the city; also to rearrange other street lamps throughout the city. New equipment will be installed in the power plant to maintain the new arc lamps.

ST. PAUL, MINN.—Plans are being considered by the Seven Corners Commercial and the West End Clubs for the installation of an ornamental street-lighting system on Seventh Street from Wabash Street to Tuscarora Street. The plans provide for 250 lamp standards, to cost about $34,000, to be paid by the property owners. The cost of maintenance is estimated at about $18,000.

CARSON, IA.—The local electric light plant, recently destroyed by fire, will be rebuilt. Either a temporary plant will be installed or a transmission line erected from the plant at Glenwood to furnish electrical service in Carson until the new plant is completed. Joseph A. Bortenlanger, of Glenwood, is manager.

CHARLOTTE, IA.—The installation of an electric-lighting system in Charlotte is under consideration.

FONTANELLE, IA.—At an election held April 9 the proposition to issue $10,000 for the installation of a municipal electric-light plant and $12,000 for a water-works system was carried. H. J. Stuhlmiller is town clerk.

FORT DODGE, IA.—The Northern Pwr. Co. contemplates rebuilding its dam at Fort Dodge this summer and erecting a transmission line west through Barnum, Manson, Pomeroy, Fonda and Newell.

FORT MADISON, IA.—The Stone & Webster Corpn., of Boston, Mass., has purchased the property of the Fort Madison El. Lt. Co. Announcement has been made that extensive improvements will be made to the system, involving an expenditure of many thousand dollars. The output of the plant will be increased and the transmission lines rebuilt throughout the city. J. A. Trawick is representative of the company.

LE CLAIRE, IA.—At an election held recently the proposition to grant the Iowa & Illinois R. R. Co. a 25-year franchise to furnish electricity for lamps and motors in Le Claire was carried. The company will also be given a contract to light the streets of the town.

McCALLSBURG, IA.—The Iowa River Lt. & Pwr. Co., of Eldora, has applied for a franchise to supply electricity in McCallsburg.

MEDIAPOLIS, IA.—The City Council has decided to call a special election to submit the proposition to grant L. R. Sherrill, of Burlington, a franchise to furnish electricity for lamps and motors in Mediapolis. It is proposed to secure electricity from the power plant of the Mississippi River Pwr. Co., at Keokuk, Ia.

OSSIAN, IA.—We are informed that the town of Ossian does not contemplate the installation of an electric-light plant. Charles Green is town clerk.

BROOKFIELD, MO.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until May 24, for the construction of the United States post office at Brookfield, Mo., including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures and approaches. Drawings and specifications may be obtained from the above office or from the custodian of site at Brookfield. O. Wenderoth is supervising architect.

EDITH, MO.—Surveys have been made for the construction of a hydroelectric power plant near Edith, to develop about 70,000 hp. The plans provide for the construction of dams 60 ft., 100 ft. and 120 ft. high, forming four lakes containing an area of from 300 to 400 miles. The cost of the two principal dams is estimated at $1,500,000. C. R. Robertson and Walter Gray, of Springfield, Mo., are interested in the project.

MAYVILLE, N. D.—Plans and specifications for the proposed municipal electric-light plant for Mayville will be out about April 28. The plans were prepared by the Oscar Claussen Engineering Co., consulting engineer, National German American Bank Building, St. Paul, Minn.

REYNOLDS, N. D.—At an election held recently the proposition to install a municipal electric-light plant was carried.

HURON, S. D.—The Huron Lt. & Pwr. Co. is contemplating improvements to its plant this year.

SIOUX FALLS, S. D.—The Bennett Engineering Co., of Sioux Falls, is installing an electric-light plant here. The equipment will consist of two 150-hp gas engines and producers and two 100-kw alternating-current generators, directly connected, with full switchboard equipment. Equipment for plant has already been purchased. A 24-hour service will be established. L. I. Bennett is interested in the company.

BENKELMAN, NEB.—At an election held recently the proposition to issue $5,000 in bonds for an electric-light plant and $20,000 for a water-works system was carried.

OHIOWA, NEB.—The electric plant which is being installed in the new Lapsheska Building will supply electricity for lighting a number of other buildings as well.

Southern States

ELIZABETH CITY, N. C.—The proposition to issue $200,000 bonds for the installation of a municipal electric-light plant and water-works system will be submitted to the voters.

WASHINGTON, N. C.—At an election to be held May 5 the proposition to issue $20,000 in bonds, the proceeds to be used for extensions to the municipal electric-light plant, will be submitted to a vote.

FLORENCE, S. C.—The Florence El. & Utility Co. is erecting a transmission line from Florence to Darlington and will furnish electricity for lamps and motors to residences and industrial plants along the route.

ABBEVILLE, GA.—At an election held April 8 the proposition to issue $8,000 for the construction of a municipal electric-light plant was carried. The town has been without electrical service since the electric plant was burned about six months ago.

AUGUSTA, GA.—Work has begun on the addition to the power plant of the Augusta-Aiken Ry. & El. Co. This addition will provide space for the equipment to be used for distributing energy transmitted from the plant at Stevens Creek on the Savannah River. The cost of the building is estimated at $20,000 and the equipment at $80,000.

COVINGTON, GA.—The Georgia Ry. & Pwr. Co., of Atlanta, has applied to City Council for a franchise to erect its high-tension transmission lines through Covington, and also has submitted a proposition to supply the city with electricity for lamps in Covington.

NEWNAN, GA.—The Columbus Pwr. Co. is negotiating with the city of Newnan to furnish electricity to operate the municipal electric-light plant here.

QUITMAN, GA.—Plans are being considered for making improvements to the municipal electric-light plant. The city may secure electricity from the plant at Valdosta.

DAVENPORT, FLA.—Preparations are being made by the Davenport Lt. & Ice Co. for the installation of an electric-light plant in connection with its ice factory and bottling works. It is understood that arrangements have practically been made for machinery for the proposed plant. C. F. Farmer and others are interested.

GAINESVILLE, FLA.—An ornamental lighting system will be installed on 13 blocks in the business district in connection with the new lighting plant. Ornamental lamp standards carrying five-lamp clusters will be erected.

TAMPA, FLA.—Arrangements are being made for the installation of an ornamental street-lighting system in Tampa.

CHATTANOOGA, TENN.—The merchants have "signed up" for the installation of an ornamental street-lighting system covering about 1½ miles.

KENTON, TENN.—At an election held recently the proposition to issue bonds for the installation of a municipal electric-light plant and waterworks was carried.

ROGERSVILLE, TENN.—The Hydro-Electric Pwr. Co., of Rogersville, is building a hydro-electric light plant at Big Creek, 4 miles east of Rogersville. The equipment of the plant will include two waterwheels, one governor, one alternating-current, three-phase, 60-cycle generator with standard switchboard equipment. About 4 miles of overhead lines will be erected and 5000 ft. of underground distribution system will be installed. Transformers, meters and lamps have not yet been purchased. Vance G. Hale, of Rogersville, is engineer in charge.

ROANOKE, ALA.—The proposition to issue $20,000 in bonds, the proceeds to be used for extensions and improvements to the municipal electric-light plant will be submitted to the voters.

ATKINS, ARK.—Arrangements are being made to organize a company here to install an electric-light plant and a cotton gin. W. H. Jones and others are interested in the project.

MAGAZINE, ARK.—Steps have been taken to organize a company to develop the water-power of the Petit Jean River to furnish electricity for lamps and motors in Magazine and other towns. Dr. H. Dacus is interested in the project.

ABBEVILLE, LA.—The City Council has granted the Louisiana Trac. & Pwr. Co. and the Southwestern Trac. & Pwr. Co. franchises to construct and operate electric railways over several streets in Abbeville.

ESTHERWOOD, LA.—The City Council has decided to install a municipal electric-light plant as soon as possible.

RAYVILLE, LA.—The city of Rayville, it is reported, is asking for bids for a franchise for installation of an electric-light plant and waterworks system. For further information address C. A. Smith, secretary of Progressive League.

LEHIGH, OKLA.—The City Council has called an election to be held on April 22, to vote on the proposition to sell the municipal electric-light plant to A. Hardgrave, for a consideration of $15,000. Mr. Hardgrave, it is stated, represents Chicago capitalists, and has purchased the electric plants in Atoka and Coalgate.

McLOUD, OKLA.—Bonds to the amount of $8,000 have been voted for the installation of an electric-light plant in McLoud.

WANETTE, OKLA.—At an election held recently the proposition to issue $8,000 in bonds for establishing a municipal electric-light plant was defeated.

BAY CITY, TEX.—Preparations are being made by the James W. Rugeley Gin Co., of Bay City, for the installation of an electrically operated gin.

DALLAS, TEX.—Bonds to the amount of $400,000 have been voted for the installation of a municipal electric-light plant. J. M. Preston is city engineer.

MISSION, TEX.—The Mission Ice, Wtr. & El. Co., recently organized, contemplates the construction of an electric plant, ice factory and waterworks system. The ice plant will have a daily capacity of 15 tons. The Robert M. McCandlish Engineering Co., of Kansas City, Mo., has prepared plans and will supervise construction.

Pacific States

EPHRATA, WASH.—The city of Ephrata is contemplating the installation of a municipal electric-light plant, to cost about $10,000, this spring.

RIVERSIDE, WASH.—Work has started on the construction of a large power plant on the Chelan River at Riverside for the Great Northern Ry. Co. It is estimated that from 80,000 hp to 100,000 hp will be developed, which will be sufficient to operate the main line from the Cascades to Idaho and the Columbia River branch north to Oroville. Robert Herzog is chief hydraulic and electrical engineer in charge of the work.

SEATTLE, WASH.—Preparations are being made by the city of Seattle for the construction on the Cedar River, about 40 miles from Seattle, of a masonry dam 200 ft. high, 800 ft. long, to impound 7,000,000,000 cu. ft. of water, for power development. Bids for construction will be received in about 30 days. A. H. Dimock is city engineer.

SEATTLE, WASH.—The city of Seattle is planning to install a steam auxiliary power plant. The equipment will include eight 625-hp boilers, equipped with stokers, either oil (side firing) or mill fuel or coal (front firing), and two 5000-kw, 2500-volt, two-phase, 60-cycle turbo-generator sets, switchboards will be built in the department shops. The city has 1860 miles of commercial wire and about 600 miles of street lines and 863,471 duct ft. of underground conduits, in which cables have not been installed, and maintains 716 arc lamps and 1631 cluster lamps. Arrangements have not been completed for the above work, but it will probably be done by day labor by the city engineer and light department. J. D. Ross is superintendent of lighting.

TACOMA, WASH.—Contract will soon be awarded by Nicholas Lawson, commissioner of light and water, for eight transformers with a total rating of 16,000 kw, to cost approximately $35,000.

TACOMA, WASH.—The St. Paul & Tacoma Lumber Co. contemplates the installation of a steam turbo-generator unit to supply electricity to operate its entire plant. The plant will have a generating capacity of 1350 hp.

ASHLAND, ORE.—The franchise for an interurban railway recently granted to M. T. Minney Co., of Oakland, Cal., by this city and Medford, has been taken over by F. B. Waite, of Sutherlin, and others. The company expects to begin work on construction of the road in the near future.

HOOD RIVER, ORE.—The installation of a municipal electric-light plant to cost $50,000 is under consideration.

MERLIN, ORE.—The California-Oregon Pwr. Co., of Medford, is erecting a power plant here. The company has its transmission lines within a few miles of Merlin and expects to furnish electrical service here within six months.

ONTARIO, ORE.—The Beaver River Pwr. Co., it is reported, is preparing to extend its service to Nyssa, Vale and Ontario. The company is extending its transmission lines throughout the Snake River Valley.

REDMOND, ORE.—Plans are being considered by the light committee of the City Council for the installation of a municipal electric-light plant. The plan contemplates the installation of cluster lamps for street lighting. No definite action has yet been taken.

UNION, ORE.—Negotiations are under way between Green Brothers, of Spokane, Wash., and the city authorities for the installation of a municipal electric-light plant. The cost of the plant is estimated at $72,000 and Green Brothers agree to take the bonds of the city in payment for their work. The Council has the matter under consideration.

BANNING, CAL.—The Consolidated Reservoir & Pwr. Co. is completing the last section of the large irrigation system in the Banning Valley, a few miles north of Banning. An electric power house will be erected along the pipe line.

EDGEWOOD, CAL.—R. W. Cavanaugh, owner of the local electric-light plant, has petitioned the State Railroad Commission for permission to sell his electric-light plant to the California-Oregon Pwr. Co., of Medford, for $10,000.

LAKEPORT, CAL.—The Mount Konocti Lt. & Pwr. Co., of Lake County, has applied to the State Railroad Commission for permission to issue $20,000 in capital stock and $5,000 in notes.

LODI, CAL.—The Oro El. Corpn., of Oroville, will begin work on the erection of a distributing system south of Lodi, in the near future.

LOS ANGELES, CAL.—The Pacific Lt. & Pwr. Co. is planning the installation of several small substations in southern California to distribute electricity generated at the Big Creek power plant.

LOS ANGELES, CAL.—The Southern California Edison Co. has applied to the State Railroad Commission for authority to purchase from the Pacific El. Ry. Co. the electric distributing systems in Gardena, Moneta, Clifton and Redondo Beach. The price given is $17,500.

MODESTO, CAL.—The Sierra & San Francisco Pwr. Co., of San Francisco, has been awarded a contract for furnishing electricity for operating the Tidewater Southern Railroad for a period of ten years. The plans of the Sierra power company provide for the construction of two power stations, one 7 miles from Stockton and the other at Modesto, involving an expenditure of about $55,000.

ONTARIO, CAL.—The city of Ontario contemplates the installation of electroilers, to cost approximately $2,000, bids for which will be called about June 1. B. B. Mann is city engineer.

PLEASANTON, CAL.—We are informed that the town of Pleasanton does not contemplate the construction of an electric-light plant, as reported in these columns in the issue of April 5. P. Rock is town clerk.

SACRAMENTO, CAL.—Plans for the installation of a municipal electrical distributing system, providing for the construction of a substation and 75 miles of pole lines, have been prepared by Albert Givan, city engineer. The cost is estimated at $113,600.

SAN FRANCISCO, CAL.—The Pitt River Pwr. Co. has applied to the State Railroad Commission for a certificate of public convenience and necessity to supply power in the northeast portion of Shasta County and in Modoc and Lassen Counties.

SAN FRANCISCO, CAL.—An agreement has been made between Messrs. Thurston and Wright, of San Francisco, owners of a large tract of land near Sheridan, in Placer County, and the Pacific Gas & El. Co., giving the latter the right to 10 acres of land on which to erect a substation. The station will be erected on the line running from Dutch Flat in this county through Placer, Nevada and Sutter Counties to Vernon, at the junction of the Sacramento and Feather Rivers. The substation will distribute electricity in the western part of Placer County.

SISSON, CAL.—George H. Johnson, owner of the local electric-light plant, has applied to the State Railroad Commission for permission to sell his electric-light plant to the California-Oregon Pwr. Co., of Medford, Ore.

TULARE, CAL.—The State Railroad Commission has granted the Big Four El. Ry. Co. permission to issue $400,000 in capital stock, the proceeds to be used for the construction of an electric railway from Tulare to Porterville and from Tulare to Visalia.

SODA SPRINGS, IDAHO.—The Utah Pwr. & Lt. Co., of Salt Lake City, Utah, has applied for a franchise in Soda Springs.

OGDEN, UTAH.—Bids will be received at the office of the chief clerk, Department of Agriculture, Washington, D. C., until May 2, for furnishing stationery and office supplies, instruments, field equipment, furniture and telephone supplies to the Forest Supply Depot at Ogden, Utah, during the fiscal year beginning July 1, 1913. Proposals, blanks with full instructions and information may be secured upon application to the chief clerk. B. T. Galloway is acting Secretary of Agriculture.

HELENA, MONT.—The Mountain States Tel. & Teleg. Co. will make improvements to its system at a cost of about $140,000. The wires will be placed underground in the business section and portions of the residence district, involving an expenditure of about $40,000. E. M. Burgess, of Denver, Col., is vice-president and general manager.

DENVER, COL.—The Colorado Pwr. Co., recently incorporated with a capital stock of $20,000,000, will take over the properties of the Central Colorado Pwr. Co. under the reorganization plan. The new company will take over the plants and transmission lines of the Central Colorado Pwr. Co., the Leadville Lt. & Pwr. Co., which was controlled by the Central company, and the Salida Lt. & Pwr. Co., recently purchased by interests identified with the reorganization committee. An extensive plan of development, including the purchase of other plants in the State, it is understood, will follow. The incorporators are: F. Gerhard, C. D. Robbins, L. B. Lord, Irving W. Day, Ernest B. Tracy, R. E. Coulsen, Charles V. Graham, William M. Evarts, George Foley, Ross A. Madsey and Harry M. Deming.

DURANGO, COL.—The properties of the San Juan Wtr. & Pwr. Co., the Durango Gas & El. Co., of Durango, and the Telluride El. Lt. Co., of Telluride, have been taken over by the Western Colorado Pwr. Co., which is allied with the Utah Pwr. & Lt. Co., of Salt Lake City, Utah. The new company will have its headquarters in this State and will have charge of the plants of the Utah company in Colorado. General Bulkeley Wells will continue as president of the company and J. A. Clay, manager of the San Juan and Durango companies, will be general manager.

ROCKY FORD, COL.—The Arkansas Valley Ry., Lt., Ht. & Pwr. Co. will erect a transmission line from Rocky Ford to Ordway, a distance of 11 miles. A new substation will be built in Ordway. The cost of the lines is estimated at $10,000. W. F. Raber, of Pueblo, is general manager.

Canada

WINNIPEG, MAN.—The City Council has passed a resolution for installing ornamental street lamps on Colony Street from Ellice Avenue to Assiniboine River, to cost about $7,500. M. Peterson is city engineer.

ST. JOHN, N. B.—A charter has been granted the St. John Suburban Ry. Co. giving it the privilege to construct and operate street railways in the suburbs of the city of St. John. The proposed railway is part of the large development for New Brunswick which is planned by John R. Graham, of Bangor, Maine, and associates. The same interests are interested in the New Brunswick Hydroelectric Co., which proposes to develop power sites near Magaguadavic and at Lepreaux. The power company will furnish electricity to operate the proposed railway.

ST. STEPHEN, N. B.—The charter of the St. Stephen El. Ry. Co. has been amended by the government, giving it the privilege of generating and distributing electricity for commercial purposes.

HALIFAX, N. S.—The government has introduced a bill providing for the establishment of a rural telephone system. It is proposed that the government should give a subsidy of $20 per mile, the farmers to furnish and erect the poles and the government to undertake the stringing of the wires. It is also proposed that the farmers purchase their own telephones and pay a small charge for connecting with exchanges in the neighborhood.

HALIFAX, N. S.—A bill has been introduced in the House of Assembly to incorporate the Halifax Tramways & Pwr. Co. The incorporators are the directors of the Halifax El. Tramway Co. The company proposes to take over the tramway company and to develop hydroelectric power. It is proposed to acquire the Nova Scotia Pwr. Co., which controls the falls on the Gaspereaux River. The capital stock of the new company is placed at $5,000,000.

BRANTFORD, ONT.—Residents of Echo Place, a suburb of Brantford, have petitioned for the installation of hydroelectric power. Parkdale, Grandview and other suburbs will follow suit. The Township Council will be asked to enter into a contract with the Hydro-Electric Power Commission of Ontario to furnish the service.

FORT FRANCES, ONT.—A report has been made by the Hydro-Electric Power Commission of Ontario on the possibilities of the Sand Island Falls, which are said to be capable, under proper storage conditions, of developing 3000 hp.

ISLINGTON, ONT.—The Town Council has decided to accept the proposition of the Hydro-Electric Power Commission for furnishing electricity for lamps and motors to the district in the vicinity of Humber Bay. Transmission will be erected from the station at Mimico to supply the service here.

KINGSTON, ONT.—The Board of Trade has asked the City Council to take up with the Ontario Hydro-Electric Commission the advisability of securing power from the Madawaska River for the city.

NORTH TORONTO, ONT.—The Hydro-Electric Power Commission is planning to extend the street-lighting system through the Glebe Manor, and provision is to be made for serving 100 houses there. The present bracket lamps now in use for street-lighting will be replaced by lamps similar to those in Toronto. About $35,000 is to be spent for improvements to the electric system in North Toronto.

PETERBORO, ONT.—The city of Peterboro has a bill before the Ontario Legislature to appropriate the plant of the Peterboro Lt. & Pwr. Co.

Miscellaneous

HAVANA, CUBA.—The Havana El. Ry., Lt. & Pwr. Co. has awarded a contract to the Westinghouse El. & Mfg. Co., of Pittsburgh, Pa., for complete electrical equipment for its large power plant, now being built in Havana. The contract calls for three 12,500-kw Westinghouse-Parsons alternating-current turbo-generators, four 100-kw direct-current generators, nine 2000-kw transformers, 20 100-lamp regulators, 2000 new-type flame-arc lamps, one complete switchboard for control of this apparatus and 24 automatic stokers, together with a complete condenser equipment.

PANAMA.—Bids will be received at the office of the purchasing officer of the Isthmian Canal Commission, Washington, D. C., until May 2, for furnishing steel, iron, wire cable, nails, nuts, etc. Blanks and general information pertaining to this circular (No. 771) may be obtained from the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Major F. C. Boggs is general purchasing officer.

New Industrial Companies

THE APPLER REFILLABLE FUSE COMPANY, of Syracuse, N. Y., has been incorporated by Grafton W. Appler, Harold C. Beatty and Owen J. Coughlin, of Syracuse, N. Y. The company is capitalized at $40,000 and proposes to manufacture electric fuses, cartridges and blocks.

THE BELLOWS TALK ELECTRIC COMPANY, of Boston, Mass., has been chartered with a capital stock of $150,000. The incorporators are: N. C. Young, A. R. Graustein and F. P. Hill, of Boston, Mass.

THE CULMER ENGINEERING COMPANY, of New York, N. Y., has been incorporated by William C. Fisher, Frank G. Riehl and Edward C. Hollis, 197 Hawthorne Street, Brooklyn, N. Y. The company is capitalized at $10,000 and proposes to do an electrical, hydraulic, mechanical and civil engineering business.

THE DORRIS ELECTRIC SPECIALTIES COMPANY, of Babylon, N. Y., has been incorporated with a capital stock of $2,000 by F. B. Knowlton, E. J. Forhan and D. A. Cashin, all of New York, N. Y.

THE ELECTRIC SALES COMPANY, of Columbus, Ohio, has been incorporated with a capital stock of $10,000 by O. L. Jeffries, M. L. Jeffries and N. E. McCleery.

THE W. C. FRITZ COMPANY, of Newark, N. J., has been incorporated with a capital stock of $125,000 by W. G. Fritz, of Orange; H. C. Van Buskirk, of Dumont, and H. C. Soldan, of Oradell. The company proposes to manufacture air compressors, electrical machines, etc.

THE FULLER MOUTHPIECE CORPORATION, of New York, N. Y., has been incorporated with a capital stock of $25,000 to manufacture mouthpieces for telephones. The incorporators are: C. V. Fuller, N. D. Moulds, of New York, and F. W. Miller, of Newark, N. J.

THE OHIO DISTRIBUTING COMPANY, of Chicago, Ill., has been incorporated by H. J. Russell, Vincent C. Mooney and Harry P. Simonton. The company is capitalized at $12,000 and proposes to deal in electrical supplies.

THE SERVICE ELECTRIC COMPANY, of Evansville, Ind., has been granted a charter with a capital stock of $40,000 to do an electrical supply business. The incorporators are: Harry A. Robertson, Ray C. Straight, De Forest H. Wood and Merrit W. Smith.

New Incorporations

LOS ANGELES, CAL.—The Salmon Lake Wtr. & Pwr. Co. has been incorporated with a capital stock of $2,000,000 by Arthur Moore, S. A. Kitchner, of Los Angeles, and A. E. Mann, of Pasadena.

PEORIA, ILL.—The Central Illinois Lt. Co. has been incorporated with a capital stock of $750,000 by A. D. Furlong, H. T. Willett and P. B. Warren. The company proposes to operate light and power plants.

WARREN, ILL.—The Warren Lt. & Pwr. Co. has been incorporated with a capital stock of $25,000 to construct and operate an electric light, heat and power plant. The incorporators are: A. J. Johnson, G. W. Scheidecker and F. T. Morrissey.

EVANSVILLE, IND.—The Sieffert El. Co. has been incorporated with a capital stock of $10,000 by Frank W. and Leo Sieffert and Fred W. Stocker.

SHOALS, IND.—The Shoals El. Lt. Co. has been chartered with a capital stock of $10,000 to generate and distribute electricity. The incorporators are Charles O. Williams, B. C. Johnson and J. T. Morris.

WILLIAMSTOWN, KY.—The Williamstown Mill & Lt. Co. has been incorporated with a capital stock of $15,000 by J. M. Riley, J. W. Shields, R. L. Webb, W. P. Stratton and G. S. Webb. The company proposes to operate an electric-light plant and grist mill.

MUSKEGON, MICH.—The Frugale Pwr. Co. has been incorporated with a capital stock of $20,000 for the purpose of generating electricity to be distributed in the northern part of Muskegon County. Frank H. Speese, Martin W. Camiford and Albert Speese are the incorporators.

STIGLER, OKLA.—The Stigler El. Lt. & Pwr. Co. has been incorporated with a capital stock of $15,000 by J. N. Ward, Claud C. Ward and F. C. Ward, all of Fort Smith, Ark.

HARRISBURG, PA.—Charters have been granted by the State Department to the People's El. Co., of Ontelaunee Township; the People's El. Co., of West Leesport; the People's El. Co., of Centre Township, and the People's El. Co., of Centreport. Each company is capitalized at $5,000 and the incorporators are: David S. Wolf, Allan A. Baver and Grant E. Alleman.

FORT WORTH, TEX.—The Eugene Ashe El. Co. has been incorporated with a capital stock of $7,000 by Eugene Ashe, H. S. Ashley and C. L. Clements.

BELLOWS FALLS, VT.—The Bellows Falls El. Co. has been incorporated with a capital stock of $150,000 by Newell C. Young, Archibald R. Graustein and Fenemore P. Hill.

BELLOWS FALLS, VT.—The Fall Mountain El. Co. has been granted a charter with a capital stock of $125,000. The incorporators are: Newell C. Young, Archibald R. Graustein and Fenemore P. Hill.

MORGANTOWN, W. VA.—The Eastern Pwr. & Lt. Corpn. has been incorporated with a capital stock of $20,000,000 to control electric-light, power and gas properties, railways, etc., in Morgantown, Wheeling, W. Va., Reading, Pa., and Vincennes, Ind., to be operated by W. S. Barstow & Co., 50 Pine Street, New York. The officers are: W. S. Barstow, president; J. B. Taylor, vice-president, both of W. S. Barstow & Co.; G. H. Walbridge, vice-president, and A. P. Taliaferro, both of W. P. Bonbright & Co., of New York, N. Y. Improvements will be made to the West Virginia properties during 1913 which will involve an expenditure of about $350,000.

WINDSOR, ONT., CAN.—The Essex County Lt. & Pwr. Co. has been organized with a capital stock of $500,000 and the following officers: Robert F. Stewart, president; A. C. Marshall, vice-president; J. V. Oxtoby, secretary, and George Wiley, treasurer, all of Detroit, Mich. The company now has a plant in Sandwich, and has completed negotiations whereby it takes over the property of the Amherstburg El. Lt., Ht. & Pwr. Co., of Amherstburg, for $12,500; the Essex Lt. & Pwr. Co., of Essex, for $13,750; the Kingsville El. Lt. Co., Ltd., of Kingsville, for $11,300, and the Leamington Lt. & Ht. Co., of Leamington, for $22,000.

Trade Publications

SPLICING SLEEVES.—Hickey & Schneider, 227 Fulton Street, New York, have issued a circular containing interesting information and the results of tests on H. & S. seamless copper splicing sleeves for splicing transmission-line conductors.

SNAP SWITCHES.—The Trumbull Electric Manufacturing Company, Plainville, Conn., has issued a circular referring to its "Circle T" snap switches. The single-pole, double-pole, three-point and four-point switches are illustrated and briefly described.

PUSH-BUTTON SWITCHES.—A recent bulletin of the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., No. 8650, illustrates and lists all of the C-H push-button switches, attachment plugs, receptacles, cord connectors, sockets and plates.

CLAY PRODUCTS.—The Laclede-Christy Clay Products Company, Manchester and Sulphur Avenues, St. Louis, Mo., in a folder with a striking cover, bearing the title "Service That Saves," tells about fireclay products for all furnace purposes in brief paragraphs.

FLASHLIGHT BATTERIES.—The American Carbon & Battery Company, 509 Olive Street, St. Louis, Mo., has recently added to its line of wet and dry batteries a new line called the American Radium flashlight batteries, a price list of which is now being distributed.

DIRECT-CURRENT GENERATORS.—In Bulletin No. 148, which superseded No. 104, issued by the Crocker-Wheeler Company, Ampere, N. J., direct-current generators, rated at from 150 kw to 1500 kw, for railway service and other heavy duty, are described and fully illustrated.

ELECTRIC SPECIALTIES.—S. R. Fralick & Company, 15 South Clinton Street, Chicago, Ill., are distributing copies of "Fralick's Special Salesman." This little publication features some of the specialties handled by the Fralick company and contains other information of practical interest.

ENGINEERING LEAFLET.—"The Remedy for Water in Compressed Air" is described in Engineering Leaflet No. 14, issued by the Harrison Safety Boiler Works, Philadelphia, Pa. Following the illustrated description of the subject matter, brief reference is made to the Cochrane separators and the excellent results they have given as air driers.

REFIGERATING MACHINES.—The Audiffren-Singrun refrigerating machine as a new-business getter and load equalizer is made the subject of a pasteboard folder recently issued by the H. W. Johns-Manville Company, Madison Avenue and Forty-first Street, New York, which offers a special proposition in this connection to central stations.

WATER WEIGHER.—In a large eight-page pamphlet the Kennicott Water Softener Company, Chicago Heights, Ill., gives information respecting the Kennicott water weigher, a device which automatically records the weight of water evaporated by boilers. This valveless device operates continuously and automatically and discharges at automatic pressure.

AIR COMPRESSORS.—The Barr "unit-compound" air compressor is the subject of a pictorial bulletin showing this apparatus in various types of steam, belt and electric drive. These compressors are built in capacities of 100 cu. ft. to 500 cu. ft. per minute, at 60 lb. to 100 lb. pressure, and are manufactured by the Pennsylvania Pneumatic Company, Erie, Pa.

TOOLS FOR CABLE WORK.—T. J. Cope, 3244 North Fifteenth Street, Philadelphia, Pa., has issued a large folder illustrating many specialties for underground electrical construction, including bond-attaching plates, winches for drawing in underground cables, cable-pulling rigging, conduit-cleaning tools, duct protectors, high-tension terminals, conduit-threading machines and others.

GENERATORS AND MOTORS—The Peerless Electric Company, Warren, Ohio, in its Bulletin No. 36 illustrates and describes its bipolar generators and motors in fractional horse-power sizes. Where individual motor equipment is required these bipolar motors have been successfully used. Their application to ventilating fans, blowers, buffing, grinding and polishing machinery is illustrated and described.

INDICATING INSTRUMENTS.—In Bulletin No. 73, recently issued by the Industrial Instrument Company, Foxboro, Mass., forty pages are devoted to the latest types of Foxboro thermometers and thermographs. These indicating and recording instruments show a marked improvement in that they are so constructed that reading of them is made exceptionally easy. A number of chart records made under different conditions are shown.

LAUNDRY MACHINERY.—The "1900" Washer Company, Binghamton, N. Y., has issued an illustrated catalog intended for the perusal of the prospective user of electric laundry equipment. The merits of the machinery are convincingly set forth. Special interest will be taken by the householder in the way "Mrs. Lee" solved the laundry problem, as attractively shown by twenty-seven pictures distributed through the catalog.

INSULATORS.—"Some Interesting Facts" about insulators are told in a booklet with this title, issued by the Hemingray Glass Company, Covington, Ky. The subjects covered include design, annealing, strains and tests. Under the latter heading are summarized and tabulated the results of some very interesting tests of about twenty-five Hemingray insulators made by Prof. Albert S. Richey and Mr. Francis J. Adams, of the Worcester Polytechnic Institute.

TELEPHONE ACCESSORIES.—In a forty-page booklet issued by the American Electric Company, State and Sixty-fourth Streets, Chicago, Ill., entitled "The Remakable Growth of an Idea," there are shown telephone brackets and holders, germ-proof glass mouthpieces and "All-ways" portable lamp brackets, utilitarian accessories for the office and home that tend to greater comfort and convenience for the user. The brackets are adjustable to any telephone, are out of the way when not wanted and within easy reach when needed, and are most compact. The many illustrations in the pamphlet effectively show the utility of these devices.

AUTOMATIC CONTROLLERS.—The Cutler-Hammer Manufacturing Co., of Milwaukee, has issued Bulletins 9630, 9632, 9640 and 9642, illustrating and describing a new line of automatic controllers for use with slip-ring polyphase motors operating on low-voltage and high-voltage circuits. New types of magnetic switches are used on these controllers, the construction and functions of which are fully described. Bulletins 6090, 6095, 6100 and 6105 describe types of automatic starters for direct-current motors, which are used in place of hand starters where it is desired to get proper acceleration and where convenience of control is essential. These starters can be placed out of the way and the motor started by merely pushing a button or closing a small switch.

Business Notes

THE PARAGON-SELLERS COMPANY has moved its Chicago headquarters from 150 North Fifth Avenue to 9 South Clinton Street.

THE STATES COMPANY has removed its office from 302 West Water Street, Syracuse, N. Y., to 19 New Park Avenue, Hartford, Conn.

THE CROUSE-HINDS COMPANY, Syracuse, N. Y., will move its Cincinnati office on May 1 to the twenty-third floor in the tower of the new Union Central Building, Fourth and Vine Streets.

THE ARMORDUCT MANUFACTURING COMPANY, London, Eng., has just received from one of the largest English railway companies a second order for approximately 100 miles of rubber-covered cable.

THE CARSTARPHEN ELECTRIC COMPANY, of Denver, Cal., is now occupying its new building at 1252 Broadway. The company is going more extensively into manufacturing operations and among other products is developing a complete line of knife switches.

THE KENNICOTT COMPANY, Chicago Heights, Ill., has recently received from the city of Philadelphia, upon the recommendation of the Franklin Institute, the award of the John Scott legacy medal, for the Kennicott water weigher. The award was made in consideration of the novelty, simplicity of design and accuracy shown by the water-measuring device.

THE W. A. JACKSON COMPANY, electrical engineer and contractor, Chicago, has received the contracts for the electrical installation in the Ontario Paper Company's mill at Thorold, Ontario, Canada. The same company has also received a contract for the electrical equipment in the Grand Calumet River power station, which is situated at East Chicago, Ind.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED APRIL 8, 1913.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,058,047. APPARATUS AND PROCESS FOR MAKING WIRE ELECTROLYTICALLY; W. E. Gibbs, Pittsburgh, Pa. App. filed Sept. 4, 1909. Copper is deposited upon an endless wire, which is passed through an electroplating vat.

1,058,048. METHOD OF AND APPARATUS FOR PRODUCING COPPER WIRE; W. E. Gibbs, New York, N. Y. App. filed Aug. 30, 1910. Copper wire is passed through depositing vat; has means for drawing and reeling resultant product and automatic means for maintaining speed of wire through vat and reeling speed in proper ratio.

1,058,051. ELECTRIC SWITCH; M. Guett, Hartford, Conn. App. filed June 20, 1912. Push-buttons operate a rocker arm.

1,058,057. ELECTRIC-FURNACE CARBON ELECTRODE; A. T. Hinckley, Niagara Falls, N. Y. App. filed Feb. 2, 1912. Has a longitudinal hole and a narrow slit extending from end to end of the electrode.

1,058,071. SWITCH; H. E. Leppert, New Britain, Conn. App. filed March 17, 1910. Push-buttons operate oscillating switch arm.

1,058,107. CONTROLLING MECHANISM; A. L. Ruthven, Topeka, Kan. App. filed April 22, 1912. For railway trains; operated by pressure from braking system; electric circuit controls operation.

1,058,113. METHOD OF TREATING WATER FOR STEAM-BOILER PURPOSES; W. C. Stuckel, Newark, N. J. App. filed May 10, 1912. Water is passed through mass of zinc and copper particles to agitate mass and set up galvanic action in water.

1,058,120. TELEPHONE MUFFLER; M. Weil, New York, N. Y. App. filed June 27, 1912. Has vacuum-jacketed walls which prevent the speech being heard by others in the room.

1,058,143. HIGH-TENSION CONNECTING INSULATOR; A. Bitter and E. Weissberg, Cassel, Germany. App. filed Sept. 4, 1912. Cartridge with fuse wire is removably seated in the connecting or leading-in insulator, with the fuse chamber connected at its inner end with the oil space of the apparatus.

1,058,176. SELECTIVE SIGNALING SYSTEM; W. E. Harkness, East Orange, N. J. App. filed Dec. 19, 1911. For railway-train dispatching work; a selector in a closed bridge of the line at each station.

1,058,178. ELECTRICALLY OPERATED APPARATUS; G. W. Hart, West Hartford, Conn. App. filed Jan. 2, 1912. Solenoid-operated device.

1,058,179. SWITCH; G. W. Hart, West Hartford, Conn. App. filed July 29, 1912. Combination of solenoid, switch arm, deter and actuating means.

1,058,184. ELECTRIC TYPE-METAL HEATER FOR LINOTYPE MACHINES; D. S. Kramer, Columbus, Ohio. App. filed April 9, 1912. Heat generated by current induced in secondary winding by passage of alternating-current through primary winding; has thermo cut-off.

1,058,200. ELECTRIC-SWITCH CONTROL; W. M. Scott, Berwyn, Pa. App. filed March 8, 1912. Circuit-breaker, electromagnetic means controlling same and a control switch in the circuit of the electromagnetic means.

1,058,219. SIGNAL DISPLAY; P. J. Chase, Los Angeles, Cal. App. filed Oct. 10, 1911. For grade crossings; pair of cross-arms rotatably mounted on a standard.

1,058,243. PROCESS OF ELECTRIC WELDING; M. Lachman, New York, N. Y. App. filed Sept. 28, 1909. Consists in butting the two pieces together with the end of one piece against an edge of the other so that when current is on and pressure is applied one piece will be split by the other.

1,058,244. INDUCTION ALTERNATOR; L. J. Le Pontois, New Rochelle, N. Y. App. filed Jan. 13, 1909. Particularly for igniting circuits; field construction and windings.

1,058,261. SIGNALING MECHANISM; R. T. Reid, Seattle, Wash. App. filed April 24, 1912. Police call; electromagnetically operated step-by-step circuit-closing device.

1,058,270. SEAT; E. E. Stephens, Los Angeles, Cal. App. filed March 26, 1912. Closet seat warmed by inclosed resistance coil; thermo control.

1,058,296. COMBINED POTENTIAL AND OVERLOAD SWITCH; E. L. Gale, Sr., Yonkers, N. Y. App. filed June 11, 1907. Electro-responsive device controls switch, and a thermostatic means controlled by current through switch controls operation of the electro-responsive device.

1,058,308. SAFETY SLOW-DOWN AND STOP MOTION FOR ELECTRIC ELEVATORS; D. Larson, Yonkers, N. Y. App. filed July 5, 1910. A dynamic brake circuit for the elevator motor.

1,058,329. AUTOMATIC KEYBOARD PLAYER; C. W. Nystrom, Karlstad, Sweden. App. filed April 27, 1910. Key-actuating devices have arc-shaped portions moved by electromagnetic means into engagement with cylinders rotating at different speeds.

1,058,380. ELECTRIC HEATER; J. F. Monnot, Paris, France. App. filed Dec. 10, 1910. Metallic envelope having hermetically sealed within it an electric resistance conductor embedded in pulverulent plaster of paris.

1,058,514. ELECTRIC-ARC LAMP; T. E. Adams, Cleveland, Ohio. App. filed July 8, 1909. Upper metallic electrode is dropped upon the lower metallic electrode successively to remove scoriaceous deposits and permit proper electrical contact.

1,058,515. ELECTRIC-ARC LAMP; T. E. Adams, Cleveland, Ohio. App. filed April 5, 1910. Additional weight is given upper electrode to cause it to strike the lower electrode with force sufficient to remove congealed slag from latter.

1,058,519. AUTOMATIC CONTROLLER; S. P. Armstrong, Fort Scott, Kan. App. filed Nov. 10, 1909. Means for operating a main controller and means governed by a master controller for actuating the said operating means.

1,058,533. AUTOMATIC RESISTANCE REGULATOR FOR TELEGRAPH LINES AND THE LIKE; E. Bélin, Paris, France. App. filed Dec. 20, 1911. Relays move a slider along a resistance; a galvanometer in series with the line controls the relays.

1,058,541. TELEGRAPHIC RELAY; S. G. Brown, London, England. App. filed Aug. 29, 1912. Thermoelectric couple, an independent heating element and mechanical means controlled by the cable circuit for varying heating effect of said element on the couple.

1,058,545. ANNUNCIATOR SYSTEM; H. Caldwell, Fort Michie, N. Y. App. filed Dec. 5, 1911. Circularly arranged magnets control an annunciator drum.

1,058,555. RECEIVING TRANSFORMER FOR WIRELESS-TELEGRAPH SYSTEMS; E. L. Colby, Auburn, N. Y. App. filed Feb. 6, 1911. Primary and secondary windings on common axis with adjacent ends separated by air space and an adjustable winding in series with one of the first windings and disposed within the same.

1,058,574. CABLE-REELING MECHANISM FOR ELECTRIC LOCOMOTIVES; D. T. Fisher, Columbus, Ohio. App. filed Feb. 15, 1909. Planetary gear transmission between motor armature and reel with a controlling brake.

1,058,587. CIRCUIT CONTROLLER; N. M. Hopkins, Washington, D. C. App. filed Aug. 25, 1911. For odometers, speedometers, etc. Battery is automatically cut out of circuit when the mechanism is not in operation.

1,058,589. ELECTRIC ANNUNCIATOR AND LIGHTING MECHANISM; P. A. Huddleston, Oklahoma, Okla. App. filed Oct. 2, 1912. For calling hotel guest; closing of switch rings bell and lights lamps in guest's room; guest operates wall switch in room and thereby cuts out bell and sends full current into the lamp.

1,058,598. TELEGRAPHER'S KEY-BUTTON CUSHION; H. A. Kelty, New Castle, Pa. App. filed May 9, 1912. A cap covers and is yieldingly supported upon the key button.

1,058,631. TELEPHONE ATTACHMENT; A. Schlosser, Dodge, Neb. App. filed May 14, 1912. Unauthorized party listening to conversation on a party line causes a signal to be given the party using the line.

1,058,635. CABLE-REELING MECHANISM FOR ELECTRIC LOCOMOTIVES; F. L. Sessions, Columbus, Ohio. App. filed Feb. 16, 1909. The armature of the driving motor is mounted within the hollow drum.

1,058,653. PROCESS FOR CARRYING THROUGH CHEMICAL GAS REACTIONS BY MEANS OF AN ENLARGED ELECTRICAL DISCHARGE; H. Andriessens, Munich, Germany. App. filed July 17, 1912. Arc is deformed by blowing a suitable medium against it and deformed arc is spread and extended linearly by subjecting it to force of a magnetic field.

1,058,673. HANGING SUSPENSION FOR ELECTRICAL TRANSMISSION LINES; T. Jervis, Brescia, Italy. App. filed Nov. 18, 1911. Pivotally supported hanger with rectangular arm extending on opposite sides thereof.

1,058,677. WATER-COOLED WELDING ELECTRODE FOR ELECTRIC SPOT-WELDING MACHINES; A. C. Taylor, Warren, Ohio. App. filed Nov. 1, 1912. Tubular electrode body with fluid connections.

1,058,687. ELECTRICAL RESISTANCE DEVICE; G. C. Marx, Elizabeth, N. J. App. filed Dec. 17, 1909. To render ventilating fans on railway cars interchangeable on lines using different current intensities; has support with insulated contact points and a sectional resistance coil removably secured to the support.